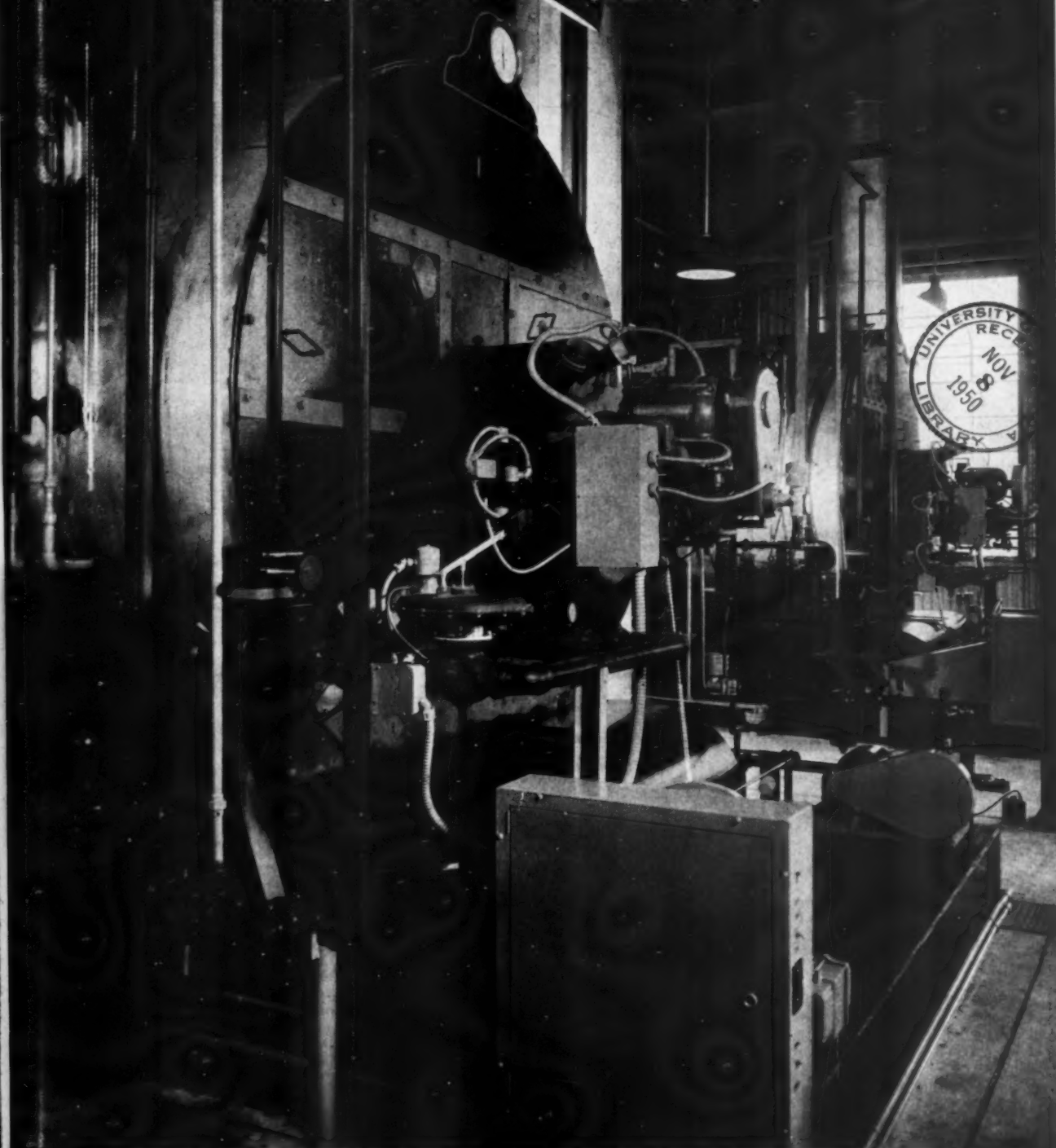
NOVEMBER 1950

INDUSTRY AND POWER

The Magazine for the Plant Engineering Group

Engineering Library



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PLEASE ROUTE TO

Superintendent	Plant Engineer	Chief Engineer	Power Engineer	Master Mechanic	Electrical Engineer	Maintenance Supt.	Purchasing Dept.

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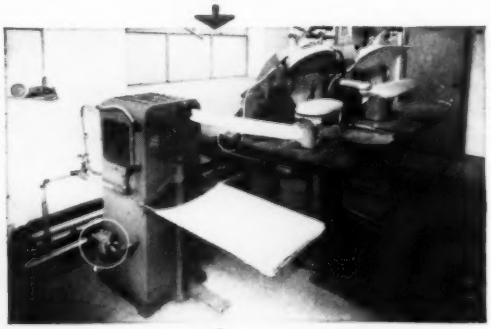
"How to get new steam traps for free"

Trade steam losses for them . . .

Cost of Steam Leaks at 100 Pounds Pressure
(Assuming steam costs 50 cents per 1000 lbs.)

Size of Orifice	Lbs. Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
1/2"	835,000	$417.50	$5,010.00
3/8"	470,000	235.00	2,820.00
1/4"	210,000	105.00	1,260.00
1/8"	52,500	26.25	315.00
1/16"	13,200	6.60	79.20
1/32"	3,400	1.70	20.40



Saves $59.62 MONTHLY — $98 for Armstrong Steam Traps cut the fuel oil consumption at Wisconsin Cleaners, Milwaukee, from an average of 1167 gallons per month down to an average of 625 gallons per month. The traps were better than "for free" — they pay back their purchase price more than seven times every year!

IT COSTS far more to live with leaky steam traps than it does to replace them with Armstrongs — the traps that pass no steam. Measure their cost against steam losses caused by traps that let steam get by (see left).

In Armstrong traps the discharge valve is water-sealed at all times—no steam gets to it. There's no chance for dirt to hold the valve open and let steam escape. Armstrong traps don't COST money, they SAVE money. Ask your nearby Armstrong representative to figure on the traps you need now.

ARMSTRONG MACHINE WORKS
820 Maple St., Three Rivers, Mich.

SEND FOR THE STEAM TRAP BOOK. It tells how to figure condensate loads, how to select traps. Includes prices, data, capacities of Armstrong Steam Traps. Write for your copy.

ARMSTRONG STEAM TRAPS

Edited specifically for the plant engineering group—the executives and engineers responsible for the generation, transmission, distribution and utilization of energy in its various forms for power, processing and engineered services

INDUSTRY AND POWER

The Magazine for the Plant Engineering Group

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Cover Illustration

Two 500-hp 150-psi packaged boilers installed in the Bethlehem plant of the Allentown-Bethlehem Gas Co. They generate 35,000 lb of steam per hr for catalytic cracking of natural and LP gases. Heating values of these gases are cut back to conform with that of manufactured gas before all three are mixed and piped to city mains.

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Rensselaer Plant Has Diesel Capacity of 7,150 Horsepower 69
Starting in 1924 with the installation of the original diesel, this municipality has gradually increased to present capacity

Dye Exposes Microscopic Cracks 70
Duplicating the long-used kerosene or oil test, this method uses a red dye to expose cracks in a white-coated surface

Purification Features Conditioning System 71
L. F. Clifford, Consulting Engineer
Of particular importance in this installation is the use of triethylene glycol to purify the conditioned air. Final temperature control is by means of individually located thermostats in zones

Light-Weight Aggregates for Construction 73
Used instead of sand and gravel, these aggregates not only make a lighter concrete, they have good insulating qualities as well

Speed Controls Increase Output and Reduce Costs 74
Louis Kasper, Mechanical Supervisor,
Francis A. Westbrook, Mechanical Engineer
Punch presses equipped with individual speed controls gave a speed range of 100 to 250 strokes per minute. Fluctuation in stroke speed is now completely eliminated and rejects are at the minimum

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Even though heating systems were checked in the early spring, here are a few hints to insure efficient winter operation

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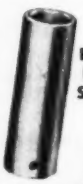
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LOS ANGELES

Acorns of Science

Developments not yet available, but of interest to the Plant Engineering Group as previews of future tools and methods

Stereo Television

● Two-dimensional television has already invaded industry and a story on how it is being used to view gages, turbine exhausts and other phenomena in places too dangerous or remote for human observation will appear in an early issue. Now the Argonne National Laboratory reports progress in the development of stereo television.

Manipulation of objects in three-dimensional space requires depth perception in both viewing and control means. The laboratory program was undertaken to study the possibilities of using three-dimensional television in conjunction with remotely controlled electric manipulators.

Electronic Umpire

● Another method of keeping track of moving objects has received its impetus from sports. Two of three phototubes, laid upon or set flush with the surface of the ground, view narrow, vertical zones in front of and behind home plate. The third tube views a slant zone which may be tilted to intersect the vertical zones at the proper heights.

A baseball passing through the zones throws shadows on the phototubes, causing pulses which are amplified and fed into thyratrons in the control circuits. Proper sequence of pulses necessary to fire all three tubes is obtained only when the ball passes through the slant zone after passing the first and before the second vertical zone. High and low pitches produce an incorrect sequence, indicating a strike. The device is from the General Electric Co. Electronics Laboratory.

Sound Measures Water Velocity

● Ultrasonic sound now promises a simpler means of finding velocity, and therefore rate of flow of water and other fluids. Transmitter and receiver of the sound waves, pitched too high to be audible, are placed on opposite sides of a duct of definite size, and are displaced a definite distance along the axis of flow. Speed of the water causes a displacement in phase angle of the sound as it passes through the duct. This angle is measured and indicated in terms of velocity. Accuracies 98% have been obtained.

R. C. Swengle, consultant who devised the idea, and two Pennsylvania Water and Power Co. engineers are working on the method and expect to overcome the remaining obstacles to large scale measurements. With turbine testing one of the first aims, installations will require relatively simple testing equipment.

New Yardstick

● Atoms and radar team up to produce a new standard of length with an accuracy of one part in 40 million, or four times that of the present international standard. Scientists of Westinghouse Research Laboratories and Allegheny Observatory place an isotope of mercury made from gold at Oak Ridge atomic pile in argon gas, irradiate it with ultra-short radio waves and measure the wave length of the resulting radiation.

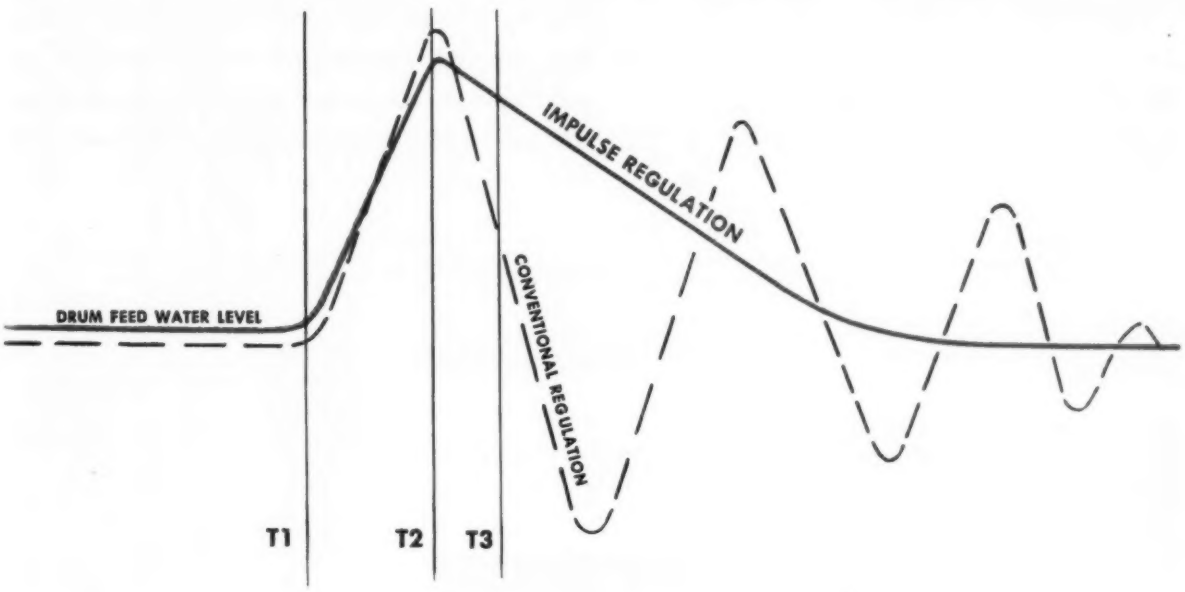
Present standard of length is based on the wavelength of red light emitted from cadmium. A new standard would have to be confirmed by three independent laboratories before being considered. Researchers are also experimenting in France and Britain.

Miniature Rocket Motor

● Tiny, liquid-fuel rocket motor that can be held in the hand is being used at the Massachusetts Institute of Technology to develop fuels for full size rocket motors. In spite of its small size, it operates on the same principle and with the same efficiency as its larger prototype, but on a greatly reduced scale. Fuel consumption is only two pounds per minute compared to twelve tons for the German V-2.

Small size is an advantage not only because of cost in testing scarce and expensive fuels but also because of greatly simplified safety precautions. Fuels generally used ignite spontaneously on contact inside the motor, develop about 300 psi and have exhaust speeds of approximately 5000 mph.

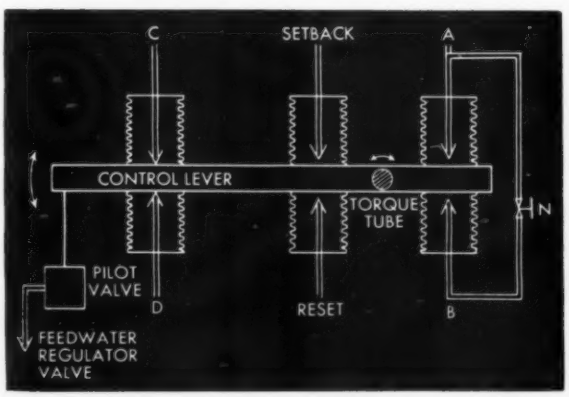
Control feed water level accurately during QUICK load change T_1T_2 with IMPULSE regulation



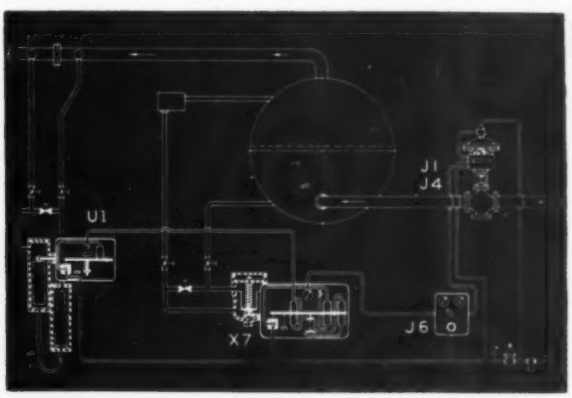
1 **COMPARE** that solid red line with the s-u-r-g-i-n-g feed water level represented by the dotted black line. Trouble is that conventional two-element systems, once adjusted for a given rate of change T_1T_3, merely react to magnitude of steam load without being able to compensate for a *different rate of change in load* T_1T_2. Since "shrink and swell" and resulting false drum level are functions of rate of change as well as magnitude of load, only Swartwout impulse regulation acts instantly and positively for *any rate of change in load* of any magnitude.

Swartwout

POWER PLANT EQUIPMENT



2 **DIFFERENTIAL LEVEL AND IMPULSE CONTROL** has setback bellows for wide throttling range and stability; reset bellows for constant level regardless of load. Bellows A, B and needle valve N, which comprise the impulse unit, convert air pressure proportional to load magnitude into an impulse reflecting *rate of change* as well as magnitude of load. This impulse cancels out drum "shrink and swell" effect (transmitted by torque tube) which is also based on rate of change and magnitude of load. Adjustment for varying water level with load is effected by bellows C, D if desired.



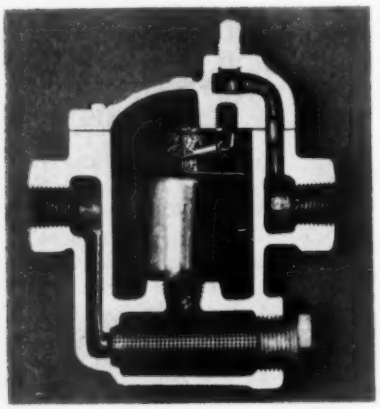
3 **SQUARE ROOT** of steam line orifice differential is taken by U1 flow transmitter which feeds air loading pressure proportional to steam flow into X7 differential level and impulse control. Regulating valve is equipped with J1 Positioneer and J4 air lock. J6 panel shows intermediate and manual pressures, provides for manual and automatic operation. In addition to this FW6 two-element impulse system, Swartwout also makes an FW7 three-element impulse feed water regulating system. Other types include the FW5 single-element system and SC (FW1) thermo-hydraulic system. A-5922

SEND FOR BULLETINS S-27, S-20-E. THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

briefing the power show

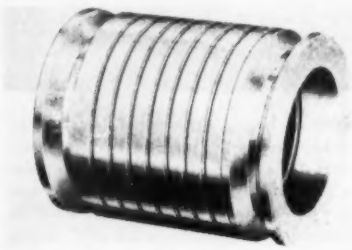
Here are new developments in the power field that you should see while visiting the Power Show Nov. 27 to Dec. 2. See the manufacturer at his booth for all particulars, or enter the key number on the postage-free card, page 117, and mail

301 Armstrong Machine Works—The small inverted bucket steam trap to be exhibited has a stainless steel strainer built right into the body and a separate strainer, thereby eliminating extra fittings and installation labor. known as the No. 881, this side-inlet, side-outlet



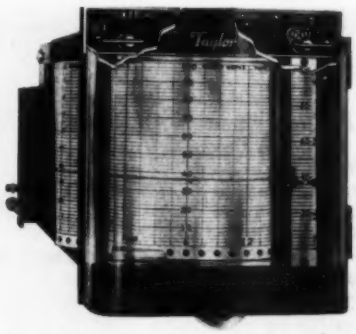
trap is used for draining smaller sized equipment producing relatively small amounts of condensate. In traps having a small discharge orifice, good practice recommends that a strainer be installed ahead of the trap to avoid clogging when dirt and scale conditions are present. Booth No. 330-332.

302 Chicago Metal Hose Corp.—New high pressure (integral ring) pipeline expansion joint called the Flexoniflex unit should be of vital interest to all engineering and operating personnel



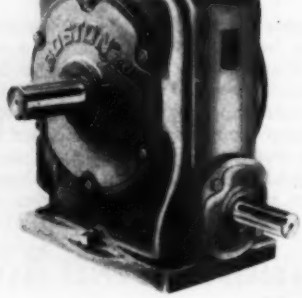
attending the show. These units, for the 1500 psi working range, have been successfully used in critical projects during the past several years. The joints consist of corrugated, bellows-type, sections of stainless steel or other alloys formed within integral control rings and end sections. Research and development of this product was made in recognition of today's trend toward ever increasing pressures and temperatures in industrial power and processing activity. Booth No. 244.

303 Taylor Instrument Companies—This company plans to exhibit in its booth, No. 370-372, a diagrammatic graphic panel for power plants. This



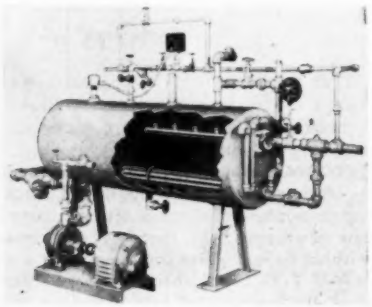
unit will show how supervision has been made easier and the panel less expensive to build. Demonstrations of the following new products will be made: Transet Tri-Act controller, Transaire temperature transmitter and power plant instruments.

304 Boston Gear Works.—Included in the new items this company will exhibit are: gear reduction units, gear self-



aligning pillow blocks and bronze oil-impregnated bearings. These products should prove of interest to the visiting engineers. Booth No. 287.

305 Fred H. Schaub Engineering Co., Inc.—To obtain full information on this company's different types of automatic boiler feed and condensate return systems visit their booth 17E. The latest



developments include a Magnetrol boiler water level control and Master-Bilt boiler feed pumps equipped with Flexi-matic mechanical seals and permanently lubricated bearings.

306 The Hays Corp.—This manufacturer of combustion and industrial instruments and controls will occupy

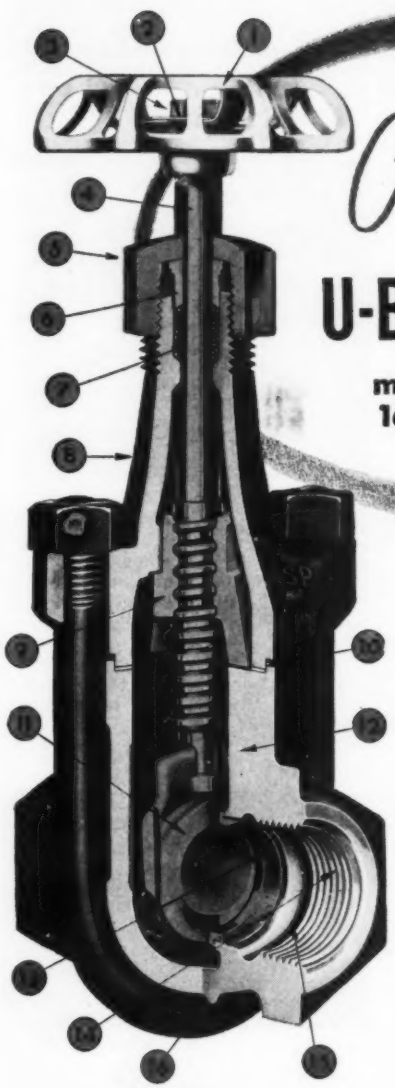
booth 68. Of particular importance will be their display of CO_2 scales, sampling and recording equipment, complete boiler panel, draft gages and recorders and flow meters.

307 DeZurik Shower Co.—Newest item in the valve line of this company to be exhibited is an air-operating unit for their line of plug valves. This develop-

(Continued on page 10)

Only Jenkins U-BOLT GATES

measure up to this 16-point standard



1. Perfect-Grip Handwheel
2. Valve Index Plate
3. Secure Wheel Nut
4. Heavy Manganese Bronze Spindle
5. Large Packing Nut
6. Self-centering Packing Gland
7. Deep Stuffing Box
8. Heavy Duty Bonnet
9. Unique Renewable Bonnet-Saver Bushing
10. Body-Bonnet Safety Joint
11. Extra-Wide Gauge Reversible Bronze Wedge
12. Heavy-Duty Body
13. Bronze Seat Rings, Expanded in
14. Full Length Pipe Threads
15. Liberal Diaphragm Clearance
16. Streng U-Bolt

PRESSURES

Screwed	Flanged
150 lbs. Steam	125 lbs. Steam
225 lbs. O.W.G.	175 lbs. O.W.G.

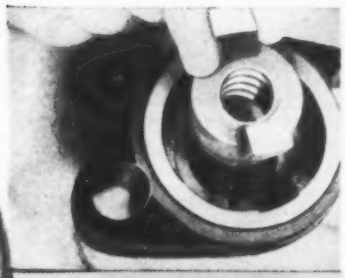
Bronze Mounted or All Iron—Sizes ¼" to 3"

TROUBLE IS RULED OUT! Check these 16 advanced features—for wear-resistance . . . for ease of maintenance. From handwheel to diaphragm, notice how thoroughly trouble has been ruled out in designing this U-bolt valve. No other valve in its class measures up to Jenkins U-bolt Gate on all these points, many of them exclusive.

You can take it apart and put it together again in two minutes, and it's a cinch to clean. When operating threads become worn, just slip in a new "Bonnet Saver Bushing" and restore it to new-valve efficiency. It's a favorite for those plumbing-heating, mine, mill or any services where excessive sediment is tough on valves and where freezing is a hazard.

For "renewability" without waste, bull-necked endurance, and low upkeep cost, you can't beat Jenkins U-bolt Valves. Yet they cost no more! Full details and specifications in new circular, Form 179-B. Jenkins Bros., 100 Park Avenue, New York 17. Jenkins Bros. Ltd., Montreal.

Sold through leading Industrial Distributors



BONNET SAVER BUSHING — No need to junk the bonnet when operating threads are worn. Just slip in a new, patented "Bonnet-Saver Bushing" and have good-as-new thread engagement.

EASY TO CLEAN — You can really get into the bonnet of this valve to clean out the chamber above the operating threads.

RUGGED CONSTRUCTION — Here's proof. When the U-bolt nut was tightened down with a 14" socket wrench until the high tensile steel bolt broke, the heavy duty body and bonnet did not crack!

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

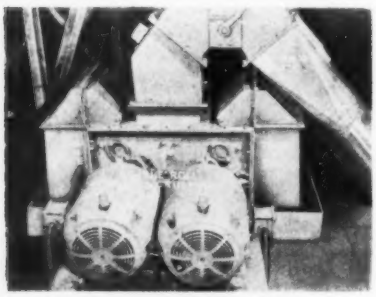
Jenkins Bros

(Continued from page 8)

ment completes a group of remote-operators that have been perfected in recent years. The new air-operator is also

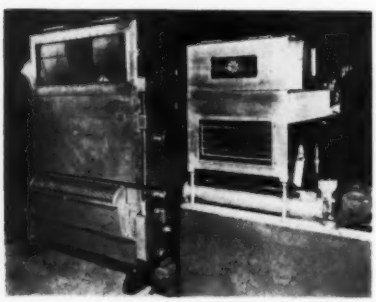
available with positioner, and supplemental equipment includes a simple air-switch, a solenoid operated air switch and a manual throttling-control station. Booth No. 305.

308 Stephens-Adamson Mfg. Co.—See this company's exhibition of conveyer equipment, which includes their Sealmaster ball-bearing carrier, natural fre-



quency vibration conveyers, and ring type Knittel crushers. All types of materials such as stone, sand, gravel and coal can be handled efficiently with this equipment. Booth No. 218-220.

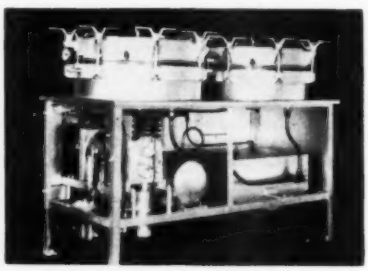
309 Niagara Blower Co.—Exhibited in booth No. 23, 24 and 25, will be equipment for the "Controlled Humidity"



method of air conditioning that employs Hygrol, a hygienic absorbent liquid, to remove atmospheric moisture without requiring refrigeration to dry the air. Also on display will be an air conditioner and the Hygrol concentrator, which provides for automatic maintenance of this absorbent liquid at full efficiency. Heat exchangers, after coolers and a refrigerant gas condenser, which is a new development with over 300 ton capacity will be shown.

310 Edward Valves, Inc.—A typical pressure loss testing hook-up, the counterpart of actual equipment used in valve design in the Edward laboratories, will be featured. The test arrangement will demonstrate, using half-section models of both conventional valve body styles and the new streamlined valve bodies, comparative flow characteristics. In particular, the superior opening action and lower pressure drop of the Edward piston-type check and stop-check designs will be demonstrated. The exhibit will also show full-scale models of globe and angle, gate, non-return, check, blow-off, feed-line instrument, and relief valves and strainers. The exhibit, which occupies booths 26 and 27, will also incorporate murals of this company's manufacturing and research procedures and typical installations. Booth No. 26-27.

311 The Hilliard Corp.—Those engineers responsible for design or maintenance of lube oil filtering in diesel or machine shops will be interested in



this company's equipment. The purification of internal combustion engine lube oil will be explained in detail. Booth No. 229-231.

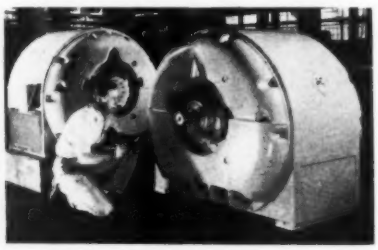
For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

312 The Permutit Co.—This company will exhibit an operating plexiglass model of a deaerating heater. Air will be blown into the unit in place of steam and the activity and flow of water will be apparent. Also displayed will be an ion exchanger that shows how a zeolite water softener can follow a hot lime soda softener and the effluent will not have to be cooled because it is not affected by high temperature or high or low pH. Booth No. 79.

313 Livingstone Engineering Co.—This company has reserved two booths, No. 203 and 380, where they will demonstrate their Speedylectric and Speedy-

therm Boilers. Most of the equipment is of the latest design and will be exhibited for the first time. An actual boiler installation will be made, and the unit will operate to generate steam at 460 F and 30 psi.

314 Allis-Chalmers Mfg. Co.—Recent additions to power equipment lines will highlight this company's display that includes a redesigned bracket-bearing



squirrel-cage induction motor and a model of a single-suction, double-case, barrel-type boiler feed pump.

Also exhibited will be a gondola car shaker; a scale model of a typical single circuit unit substation; and a demonstration of the company's remote indication system. Booth No. 3 to 5.

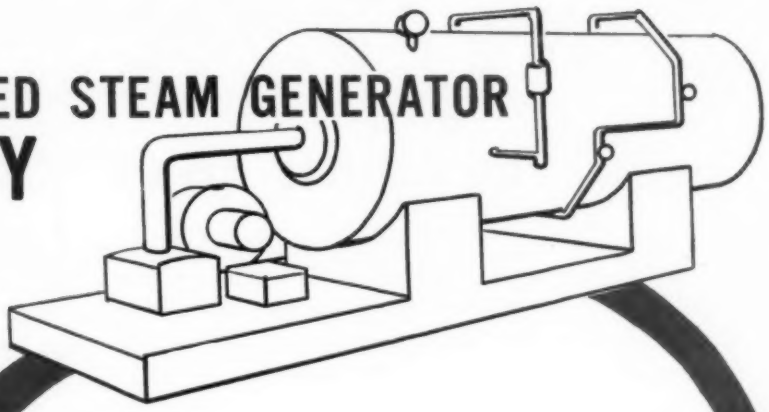
315 The V. D. Anderson Co.—At the exhibit of this company you will see their latest forged steel traps in small sizes. These units are light in weight and range from ½ to ¾ in. in diameter. No. 340 is for either straight line or elbow installation. Trap No. 60 has a bottom inlet and top outlet. Operating conditions for both traps are to 500 psi and 800 F. Booth No. 83.

316 Wm. W. Nugent & Co., Inc.—This company's exhibit will consist of pressure and gravity type oil filters of various sizes and fittings, such as sight feed valves, sight flow indicators and compression union fittings, which are used extensively in oiling systems. A recently developed full flow oil strainer, which is used for diesel locomotives will

(Continued on page 14)

Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT

SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE

FUEL SAVING . . . CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION

6218 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM • Serving Industry through Practical Applied Science

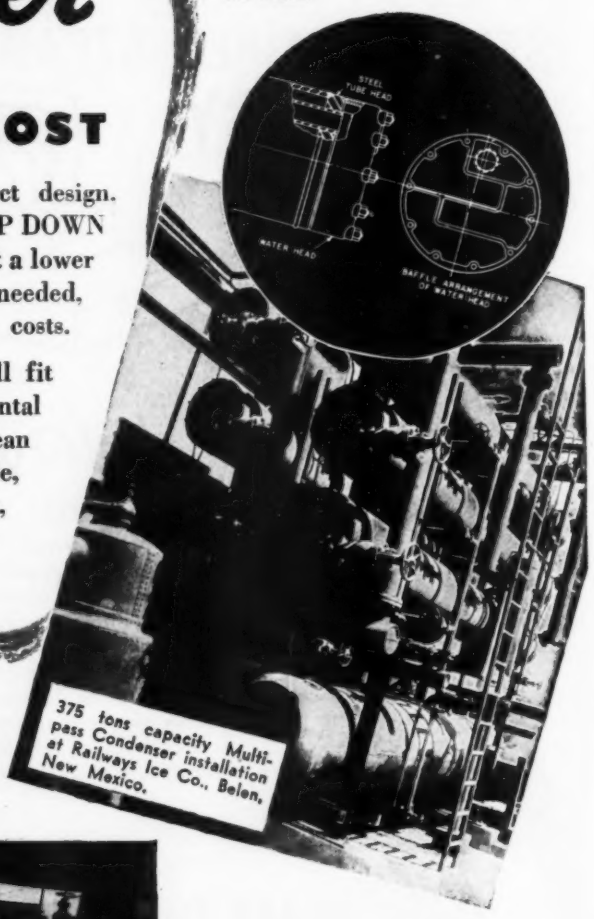
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design. STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

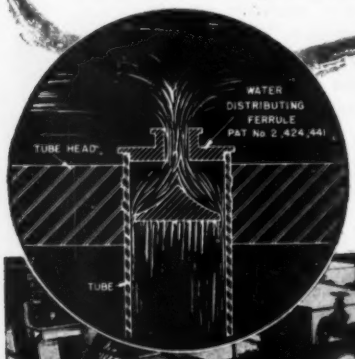
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation. are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

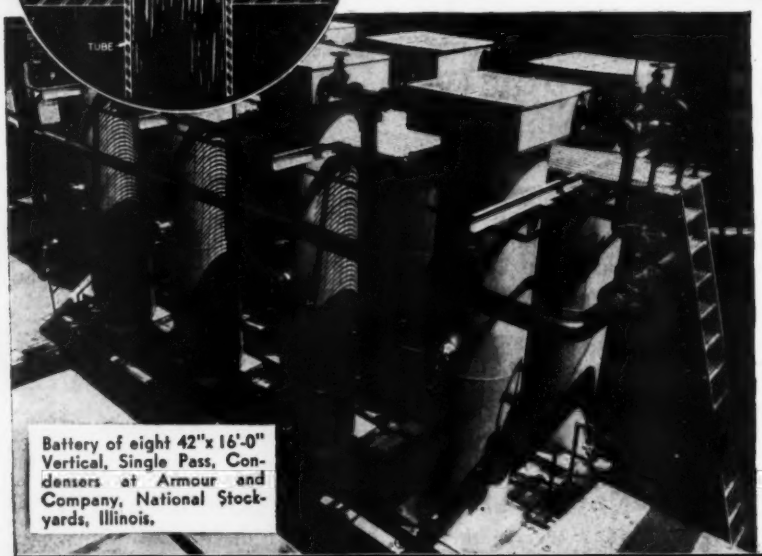


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

No. 5 / Quick Quiz on Copper Piping

Q What evidence is there of copper tube's satisfactory performance in heating systems?

A The substantial, growing trend to use copper tube in all types of heating systems, notably forced-circulation hot water and radiant panel heating.

Q What are some of copper tubing's advantages?

A Durability, flexibility, light weight, labor savings and low total cost.

Q What about freezing?

A Try to avoid it, but remember that soft annealed ANACONDA Copper Tubes are highly ductile and can usually withstand several freezings with little possibility of damage.

Q Can you tell me more?

A

Lots more. Just send for Bulletin C-24—full of useful data about ANACONDA Copper Tubes and their many industrial applications. Just write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

For better Piping . . . use

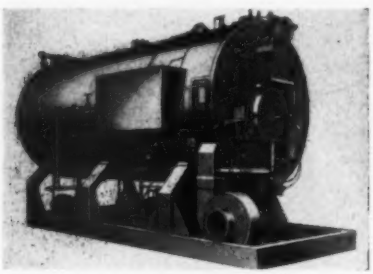
ANACONDA®

COPPER TUBES

(Continued from page 10)

be shown. This strainer contains a basket with very fine mesh stainless steel wire. The feature of this strainer is the basket, which may be dismantled to facilitate cleaning. Also displayed will be a model of the reciprocating engine to illustrate the working of telescopic oilers. Booth No. 239.

317 Ames Iron Works—Look for booth No. 77 where this company is demonstrating its Amesteam generator. This



packaged steam boiler has been designed for performance and service, it is fully automatic in operation, and it is compact. Sizes range from 10 to 500 hp with operating pressures from 15 to 200 psi.

318 J. E. Rhoads & Sons—This company's exhibit will be built around leather packings . . . showing a new plastic demonstrator equipped with leather packings. Their Tannate belted short center drive, together with various grades of flat leather belting, round belting and textile strapping will be offered for review. Booth No. 269-271.

319 The American Brass Co.—Be sure to see this company's exhibit of electrical wiring conduit that has undergone recent improvements. The con-

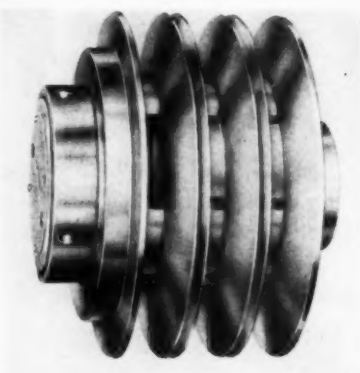
duit is liquid tight and flexible and ranges from ⅜ to 1¼ in. nominal size. A synthetic jacket is extruded over an all-metal flexible galvanized steel tubing. Application is for electrical protection from water, oil, grease and chemicals in hard-to-get-at places. Booth No. 56-57.

320 Leeds & Northrup Co.—Two new developments of interest to public utility engineers are to be displayed by this company. Both of these new products are demonstrated in operations simulating actual plant application. First of these is a system that provides virtually instantaneous transmission of electrical load data from a remote location to a central dispatching point. Response is so fast that load changes at the metering point begin to show at the receiving recorder within only a few seconds.

Advance showing is also made of a new technique in automatic combustion control that links directly from the tie line to the boiler firing equipment that applies changes in electrical load directly to boiler control. Booth No. 22.

321 Geo. P. Reintjes Co.—This company intends to exhibit one of their stud-protected floating wall constructions, a single hung suspended arch and wall, and a refractory-hung insulated arch. Those visiting this booth will be interested in learning how boiler furnaces can be lined simply and effectively to assure good boiler operating conditions. Booth No. 33.

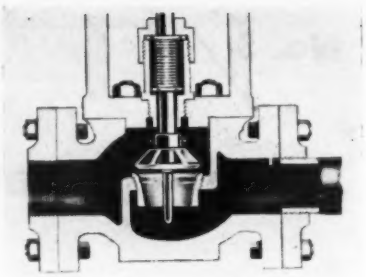
322 The American Pulley Co.—At this company's booth those interested in power transmission drives will find a new double-taper adjustable-diameter



wedge type sheave for V-belt. This unit is easily assembled onto shafts and is unlocked and removed without binding of parts. The sheave will not freeze and can be adjusted with ease. Booth No. 274-276.

323 Buffalo Meter Co.—Their exhibit will cover displacement type meters for measuring liquids. These liquids include practically all commercial liquids such as cold water, hot water, petroleum products, solvents, vegetable oils and chemicals. Features of the exhibit will be a hot water and chemical meter. This hot water meter is the most workable and practical unit developed for volumetric measurement of boiler feed water or condensate or process hot water that functions dependably for a long period of time despite the lack of lubricating properties of hot water. Booth No. 69.

324 The C. E. Squires Co.—At booth 468 will be shown steam specialties and in particular the Squires pilot operated reducing valve. This valve is noted for being (1) positive dead end—single

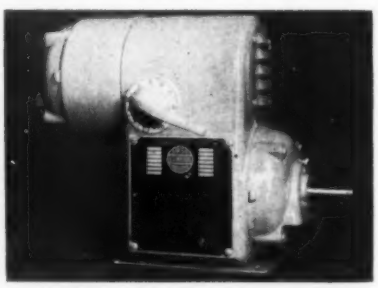


seated; (2) large reduction—from 600 psi to oz in one step—no intermediary valves necessary; (3) close regulation—within oz of desired pressures; (4) low maintenance—few repair parts, less time and labor to repair and less operating time lost.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

325 Strong, Carlisle & Hammond Co.—The complete line of steam specialties, manufactured by this company, will be on exhibition in booth 572. This line includes steam traps, strainers, reduction valves, block steels and separators. One feature will be the new 070 steam traps, which are furnished with and without a strainer.

326 U. S. Electrical Motors, Inc.—At the booth of this company visiting engineers will view a new variable drive



unit with a speed variation of 4 to 10, 000 rpm. This design comes in ¼, ⅓, ½ and ¾ hp sizes. In addition several new sanitary motors will be exhibited. Booth No. 289.

327 E. F. Drew & Co., Inc.—Emphasis will be placed on their new anti-precipitating agents, and equipment will be used to demonstrate the effectiveness of the material. The anti-precipitating agents are used largely for evaporator treatment. They have found wide application in water evaporators but especially in sugar evaporators in the sugar manufacturing process. Materials are very specific in their action in controlling

(Continued on page 16)

CHROMALOX

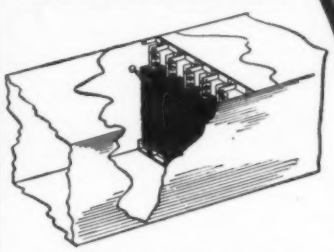
STRIP HEATERS

solve hundreds of heating problems

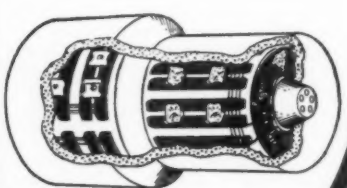
In straight lengths, curves, rings, segments and with fins. 4½" to 95" lengths; ¾" to 2½" width. Iron, steel and alloy sheaths.

efficient · dependable · low cost
electric
heat for Processes and products

TYPICAL APPLICATIONS



Chromalox Electric Fin-Strip Heaters mounted in air ducts.



Plastic extrusion barrel with Chromalox Ring, Straight and Curved Strip Heaters.

IC-50

Easy to Install CHROMALOX Electric Strip Heaters give clean, dependable and accurately controlled heat. They are widely used in platens, dies, kettles, tanks, ovens, air ducts and other applications requiring accurate temperature control and around-the-clock service.

If you are a user of heat, either in processes or products, you can get many valuable application ideas by sending for the booklet below. On-the-job engineering assistance, without obligation.

CHROMALOX

Electric Heat for Modern Industry

WANT MORE FACTS?

Send for this booklet of application ideas you can adapt for use in your plant. Write for your free copy today.

EDWIN L. WIEGAND COMPANY

7520 THOMAS BLVD. · PITTSBURGH 8, PA.

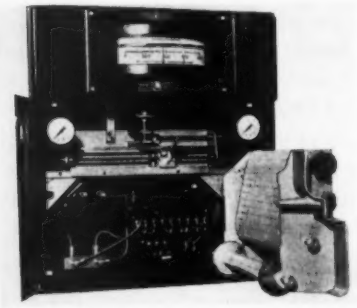
(Continued from page 14)

scales that are very objectionable in the sugar manufacturing field, for example silicate or oxalate. In the industrial water field the materials also have been found to be very effective in all types of evaporators. The materials are also very effective in controlling deposits where water is needed without concentration. This method, for general industrial usage, permits heating to the boiling point. Booth No. 434.

328 Wright Hoist Div.—If you have a lifting problem in your plant visit booth 280 where this division of Amercan

Chain & Cable Co., Inc. has its display. These electrically operated hoists range in capacity from ½ to 10 ton.

329 Wheelco Instruments Co.—Among the products exhibited by this company will be their air-operated strip chart recorder. This recording controller incor-



porates the "Wheelco Electronic Link", and it will prove of interest to those concerned with measuring temperatures, speed, flow or static strain loads. Booth No. 222.

330 Crane Co.—At this show will be featured a large pressure-seal bonnet automatic stop-check valve of improved design, developed for use on high-temperature, high-pressure piping in central power stations and large industrial plants generating their own power. Also to be shown is a completely new line of high-pressure valves, called lip seal valves, which will be available in sizes ½ to 2 in. Booth No. 53.

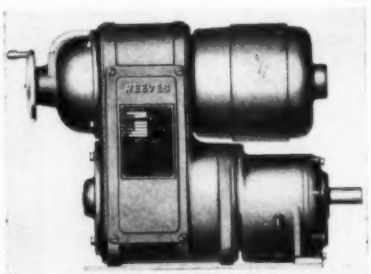
331 The Johnson Corp.—The exhibit of this manuiacturer will cover a line of steam specialties and boiler room equipment. Featured will be operating demonstrations of types "S" and "L" rotary pressure joints and a direct operated solenoid valve. Emphasis will also be placed on a high temperature boiler feed system with detailed blow-ups to tell the story of its money-saving operation.

Types "S" and "L" are newer variations of Johnson joints, which are used wherever steam or liquids under pressure must be admitted to rotating machine parts. Type "S" is completely self-supporting halting the threat of rapid wear that comes with misalignment. Type "L" has lugs cast on bodies to permit simple rod support. The joints are completely packless, self-lubricating and self-adjusting. Visitors to the exhibit will see them in actual operation. Booth 334-336.

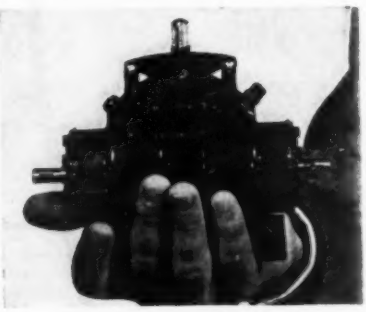
For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

332 James G. Biddle Co.—This company has planned to exhibit the following electrical testing and measuring equipment: rectifier-operated meg type of megger insulation tester; dual-operated meg of megger insulation tester; frahm miniature resonant reed tachometers; CVM type of megger insulation tester; CVM type of megger ground tester; high range megger insulation tester; Jagabi centrifugal hand tachometers; and "TTR" transformer turn ratio set. Booth No. 354.

333 Reeves Pulley Co.—Their three basic units will be stressed at this exhibition to illustrate how the variable speed control and power transmission units operate. Of particular interest will be the fractional horsepower Motodrive and variable speed Motodrive that are controlled hydraulically or pneumatically. Booth No. 34-35.

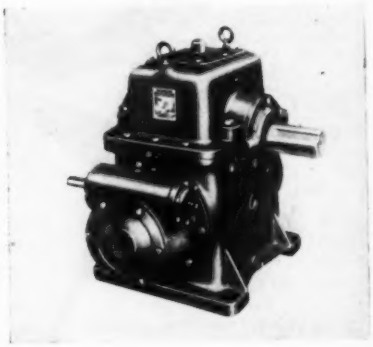


334 Graham Transmissions Inc.—This company will feature two variable speed transmissions at the show that have



just been developed. Model 10 is a small unit adaptable for loads of 1/20 hp or under, while the other new design, Model 300, is for 1½ to 3 hp applications. Booth 425-426.

335 Foote Bros. Gear & Machine Corp.—Gears, gear reduction units and gear motors will be shown by this company



in booth 214-216. Featured will be their Duti-Rated gears, Hygrade drives, Maxi-power drives, straight line reducers and worm gear drives.

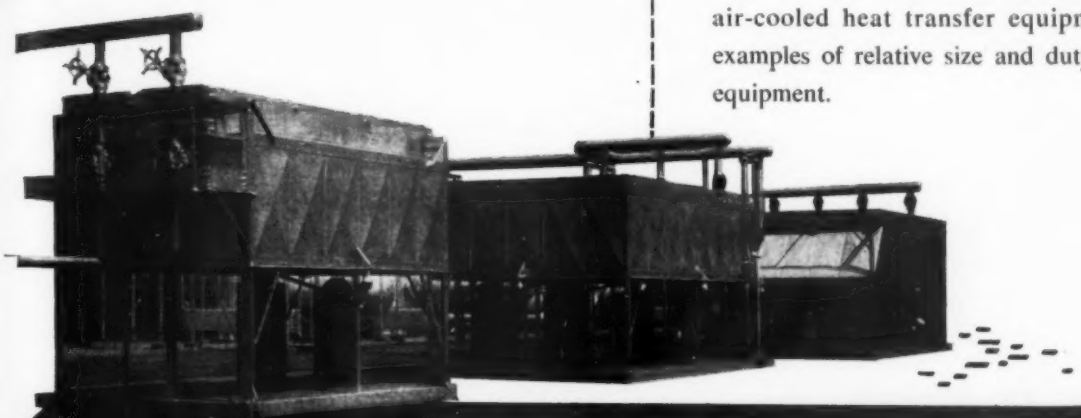
336 The Wm. Powell Co.—This exhibit will be built principally around a new line of small size, high pressure, cast steel valves designed for such services as high pressure steam, boiler feedwater, by-pass, instrument and throttling in the 1500 to 2500 psi class. Outstanding feature is one-piece body and bonnet construction. Other points of interest are a deep packing chamber, a long disc guide that centers the disc in the seat and prevents chattering in throttling service, hard faced Stellite seat and disc, accessibility of all internal parts, and the ease with which valves can be disassembled. Booth No. 63.

337 Hungerford & Terry, Inc.—The main item exhibited by this organization will be a new size poppet type central control valve. The new size valve will make available an industrial type, electrically operated central control unit

(Continued on page 20)

Here are 15 TYPICAL APPLICATIONS for FIN-FAN AIR-COOLED Heat Exchanger Equipment

For many years, Fin-Fan Air-Cooled Heat Exchangers have proved their worth by giving reliable, economical service in many and varied applications. The Fluor Corporation, Ltd., and Griscom-Russell Company, pioneer-partners in the air-cooled heat transfer field, offer the following to show the large variety of practical applications for air-cooled heat transfer equipment and examples of relative size and duty of such equipment.



GAS COOLING	Natural Gas After-Cooler	13,920,000	80	46' x 25'
	Manufactured Gas Cooler	11,165,000	50	23' x 21'
	Natural Gas After-Cooler	3,400,000	15	11' x 21'
	Natural Gas Inter-Cooler	7,890,000	40	23' x 21'
VAPOR CONDENSING	Reflux Condenser	18,407,000	90	48' x 25'
	Primary Condenser	4,652,000	40	11' x 25'
	Still O.H. Condenser	4,875,000	34	16' x 21'
	Debutanizer Condenser	11,930,000	60	23' x 25'
	Still Reflux Condenser	39,110,000	60	46' x 25'
	Steam Condenser	87,300,000	300	138' x 31'
	Steam Condenser	2,880,000	10	10' x 6'
LIQUID COOLING	Vegetable Oil Cooler	628,000	15	6' x 17'
	Absorption Oil Cooler	14,915,000	100	32' x 17'
	Quenching Oil Cooler	1,665,000	50	23' x 25'
	Amine Solution Cooler	19,300,000	175	38' x 25'
	Stabilized Crude Cooler	125,100,000	700	315' x 25'
	Jacket Water	2,400,000	5.5	16' x 12'
	Jacket Water	28,800,000	100	70' x 24'

A new 8-page bulletin on Fluor-GR Fin-Fan Heat Exchangers is now being prepared. Write in and reserve your copy by post card or letter.

Why Fluor-GR Fin-Fans Lead The Field

The Fin-Fan Air-Cooled Heat Exchanger is unique in its development and manufacture. It is the result of the engineering skill of *two* companies, *each* long recognized as leaders in their respective fields. It combines Fluor's experience in the design, fabrication and field erection of air-moving systems with Griscom-Russell's experience in heat transfer.

Success is evident in repeat orders. Since 1941, hundreds of Fluor-GR Air-Cooled Heat Exchangers have been installed throughout the world . . . nearly 50% have been repeat orders!

FLUOR

BE SURE WITH FLUOR

ENGINEERS • CONSTRUCTORS • MANUFACTURERS

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif., *Offices in principal cities in the United States*
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DIRECT CURRENT

T USERS—

BUFFALO ELECTRO-CHEMICAL ORDERS THIRD AND FOURTH I-T-E MECHANICAL RECTIFIERS

Here in a nutshell is the power conversion news of the year! After pioneering the first mechanical rectifier installation in the U.S.A., the management of Buffalo Electro-Chemical Company, Inc., Buffalo, N.Y., again has chosen the I-T-E Mechanical Rectifier to furnish power for a modernization program.

Deciding factors in Buffalo's decision were the mechanical rectifier's high inherent efficiency, small space requirement, low maintenance cost, and ease of operation.

The two original rectifier units, both rated at 3500 amperes, 260 volts d-c, have given 96.6% effici... their instal...

HERE'S NEWS FOR *You!*

MORE INDUSTRIAL ORDERS FOR MECHANICAL RECTIFIERS

Further power conversion news has been made by the following companies, who have placed orders for their first I-T-E Mechanical Rectifiers.

GENERAL MOTORS CORP.
Janesville, Wisc.

•

HERCULES POWDER CO.
Hopewell, Va.

•

SUPERIOR GAS & EQUIPMENT CO.
Philippine Islands

•

U. S. METALS REFINING CO.
Cartaret, N. J.

•

MARATHON PAPER MILLS OF CANADA, LTD.
Marathon, Ontario, Canada

•

IMPERIAL CHEMICAL INDUSTRIES, LTD.
Cheshire, Runcorn, England

•

PENNSYLVANIA SALT MFG. CO.
Wyandotte, Mich.

•

FIELDS POINT MANUFACTURING CORP.
Providence, R. I.

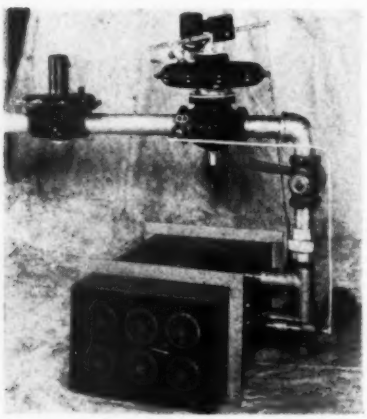
These companies join the growing list of users of the mechanical rectifi... The many adv... mechanical rectifi...

I-T-E

(Continued from page 16)

practical for use on softening machines down to a 24 in. diameter unit. Booth No. 554-555.

338 John S. Zink Co.—Combination gas and oil burners developed by this company are to be exhibited in booth 348.



The unit is made for either forced or natural draft, and it will operate with both fuels in combination. Also on display will be series STV gas burner.

339 Manning, Maxwell & Moore, Inc.—In booth 89 will be found the Shaw-Box Crane & Hoist Division's new one-ton capacity load lifter electric hoist in which are incorporated many advanced operating construction details. Among its outstanding features are unusual compactness and accessibility that makes servicing easy, as the hoist need not be taken down from the overhead support or track. Push button controlled with only 24-v at the push-button station gives additional safety. Main frame is steel, housings and covers are aluminum alloy. The motor brake is a new conception of an electric brake that has multiple discs with the friction discs operating in oil. Motor mounting will receive any standard make of motor with a NEMA flange mounting.

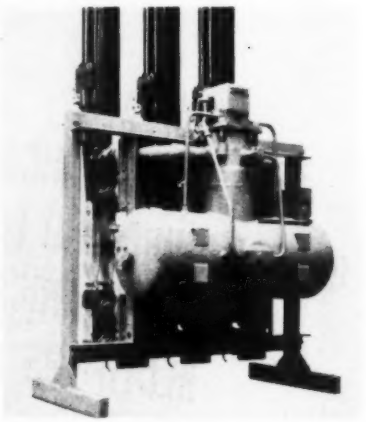
340 U. S. Hoffman Machinery Corp.—A small portable cleaner, incorporating the heavy-duty advantages of larger machines, manufactured by the Air Appliance Div., will be exhibited in booth

435-436. Identified as No. 15, the new cleaner is a 1½ hp machine operating one 35-ft length of cleaning hose. Overall dimensions are compact, width is 21½ in., length, 40½ in., and height, 43¼ in. The unit has been designed to be fitted with standard open-type motors or Class I Group D and Class II Group G for use in hazardous locations.

341 Milton Roy Co.—In booth 433, this manufacturer will show new types of controlled volume chemical pumps. A hydraulic pressure generator will be featured. This unit is a self-contained, fully automatic, hydraulic system developed for hydrostatic test purposes in all pressure ranges up to 25,000 psi. New "aiRoy" and "aiRoymetric" air powered controlled volume pumps also will be shown. For the first time the company will exhibit its new pH control system with pump meters and other control equipment, demonstrating an actual system in operation. A new "mini-Pump" for pumping and metering minute quantities (3 ml to 800 ml per hr) of clear liquids at pressures up to 1,000 psi, may also be examined.

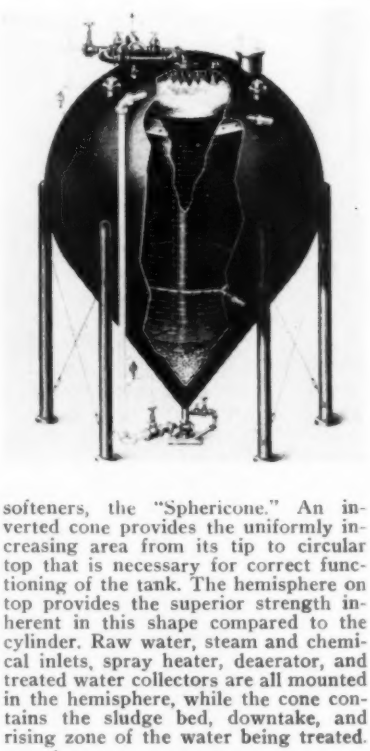
342 J. H. Williams & Co.—When visiting booth 498 you will see how this company's reversible tongs will turn pipe in either direction without removal and no lost time in reversing the action. Outer jaws can be removed to make an efficient fitting tong for narrow beads and flanges. Jaw removal is accomplished by taking out the single standard bolt and nut used in assembly.

343 Brown Boveri Corp.—At booth 36-37, you may examine this exhibitors' Trafoscope, gas responsive transformer



relay; Airblast-load break switch, 7 5/15 kv, 600 amp; the Airblast circuit breaker, 1,500 amp, 15 kv, 600,000 kva; and variable speed commutator motors, 145 hp, 218-870 rpm.

344 Graver Water Conditioning Co.—If you stop at booth 453, you may inspect this company's revolutionary sedimentation tank for hot process water



softeners, the "Sphericone." An inverted cone provides the uniformly increasing area from its tip to circular top that is necessary for correct functioning of the tank. The hemisphere on top provides the superior strength inherent in this shape compared to the cylinder. Raw water, steam and chemical inlets, spray heater, deaerator, and treated water collectors are all mounted in the hemisphere, while the cone contains the sludge bed, downtake, and rising zone of the water being treated.

Which of these **B&W** *"specialists" is your problem-solver?*

Each of these B&W Refractories is a "specialist." Each is designed to do a particular job under specific furnace conditions. This complete line of B&W Refractories is the result of years of practical research and development in the refractory field. That is why your B&W Refractories Representative can make expert unbiased recommendations to solve your individual problems and assure profitable, efficient furnace operation.

HEAVY FIREBRICK

For furnaces with slagging, flame impingement and spalling conditions, either *B&W 80* or *Junior Firebrick* can be used. 80's assure uninterrupted service at extremely high ratings. Juniors are recommended where load bearing and temperature requirements are less severe, but too severe for the best grades of fireclay brick.

INSULATING FIREBRICK

B&W Insulating Firebrick have the lightest weight and lowest heat conductivity of any insulating firebrick in their class. They store and conduct less heat — withstand direct exposure to furnace gases. Available in six types for temperatures from 1600 F to 2900 F.

PLASTICS

Used widely for repairs and for forming special shapes *in place, B&W Plastic Moldable* and *B&W Plastic Chrome Ore* offer long life under severe conditions. Plastic Moldable is suitable for use in the great majority of furnaces. It withstands temperatures up to 3000 F. Plastic Chrome Ore is ideally suited for severe slagging conditions.

CASTABLES

In furnaces that require the high resistance of chrome to chemical attack and where speed of installation is important, B&W offers *Kromecast* for temperatures up to 3100 F and *Hydrochrome* for temperatures up to 2800 F.

For burner openings, door linings, walls, roofs and arches, B&W *Kaocast* possesses unusual volume stability and resists spalling. It easily withstands temperatures up to 3000 F.

B&W Baffle Mixes are excellent castables for the construction of monolithic boiler baffles, door linings and other general uses. They are smooth and flow easily, have high strength in small sections. Widely used to withstand temperatures as high as 2600 F.

B&W Insulating Concrete Mixes combine refractoriness, light weight and low heat conductivity with the ability to be poured like ordinary concrete. For temperatures up to 2200 F.

MORTARS

B&W Mortars — Selecting the right mortar is vitally important to long refractory life. B&W Mortars pay for themselves by saving time in application and by satisfactorily performing their jobs under the designed furnace conditions.

When relining your boiler furnace, call in a B&W Refractories Engineer. He will be glad to recommend the type of refractory best suited to your needs.

B-373

B&W REFRACTORIES PRODUCTS

B&W 80 FIREBRICK • B&W JUNIOR FIREBRICK
B&W 80 GLASS TANK BLOCKS • B&W INSULATING FIREBRICK
B&W REFRACTORY CASTABLES, PLASTICS AND MORTARS

•

OTHER B&W PRODUCTS

Stationary & Marine Boilers and Component Equipment
Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers
Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

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new bulletins and catalogs

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BOILERS, AUXILIARIES, ACCESSORIES

Dual Circulation Boilers (A). Concerned about your steam purity? The ability to produce steam of super purity is only one of the advantages pointed out in a 16-page bulletin. This book explains the principles of dual circulation and describes applications for high and low make-up plants. Employs 2-color charts and drawings along with diagrammatic sketches to illustrate important points. Foster Wheeler Corp.

Auxiliaries (B). Low, medium and high pressure blow-off valves, water columns and gages, liquid level indicators and recorders, expansion joints, steam traps and other steam plant equipment are described briefly in 12-page illustrated general catalog. Yarnall-Waring Co.

Steam Condensers (C). Sound engineering practice, years of field maintenance and operating experience are combined to produce Conseco's steam condenser products. Illustrated 24-page bulletin, divided into sections on installations, engineering, maintenance, and specialties describe the units. Condenser Service & Engineering Co., Inc.

Bulletin Index (D). Here is a folder that lists this company's catalogs. High-pressure power plant auxiliaries, chemical process equipment and allied industrial equipment are the products listed according to application, together with the numbered bulletin pertaining to each. Schutte & Koerting Co.

Packaged Boiler (E). Compact, ready-to-use steam generating unit, completely shop-assembled for unit shipment is described in 12-page brochure. Pictures and diagrams illustrate the gas flow method, soot blower arrangement, furnace and boiler wall construction, and the packaged control cabinet. Capacities, dimensions, and shipping weights of the standard sizes are included. The Babcock & Wilcox Co.

Coal (F). Of interest to coal purchasers is an 8-page booklet on steam coals and metallurgical coking coals. Coal sources and processing facilities are pictured and described along with factual information on coals. Clyde E. Speer Coal Co.

PRIME MOVERS: DIESELS, TURBINES, COMPRESSORS

Power Equipment (G). Products commonly used on power generating, transmission and distribution systems are briefly presented in 28-page illustrated bulletin. Included under generation are steam and hydraulic turbines, generators and such auxiliary equipment as condensers, pumps and water conditioning. Miscellaneous transmission and distribution equipment are also covered. Allis-Chalmers Mfg. Co.

Heavy Duty Compressor (H). Two lines of stationary air compressors, one designed for normal industrial pressures of 100-125 psi; the other rated at 200 continuous, and up to 250 psi on intermittent service, are described in illustrated 8-page bulletin. Shows various sizes and models and gives cross-sectional views, engineering data and specifications. Ingersoll-Rand Co.

Portable Compressor (I). Folder gives specifications and special features of new self-contained, gasoline-powered, portable compressor. Illustrates many applications. Ingersoll-Rand Co.

WATER AND LIQUID TREATMENT

Packaged-Boiler Water Treatment (J). Don't use hit or miss methods—protect your packaged boiler with a special adaptation of the same program used in large power plants. A 4-page bulletin explains the four essential points of this water treatment system; they are service, chemicals, feeding and control. A service contract plan offers protection and security to operators of small boiler installations. National Aluminate Corp.

Boiler Water Treatment (K). Eliminate boiler deposits with this complete treatment. Booklet gives a comprehensive description of the methods prescribed. Pictures and illustrations show how it's done. The Power Chemicals Div., E. F. Drew & Co., Inc.

Filters (L). It takes only 20 minutes to clean these all-purpose filters; merely adjust a few valves and the backwashing system does the job without manual labor. Detailed information on sizes, capacities, motors etc., is given in 8-page, 2-color booklet. Titeflex, Inc.

Small Size Water Softener (M). For plants where requirements are less than 100 gpm there is the "Junior" zeolite softener. In two groups of sizes, each available in single or double units, with greensand, synthetic gel and resinous type zeolite material according to your needs. Bulletin gives all the details including drawings, dimensions and capacities. Cochrane Corp.

Algae & Slime Control (N). Manufacturers who are confronted with the problem of algae and slime in cooling towers will find this literature of great help. It is a report of the experiments and final results on the addition of bromine to control such growths. The Dow Chemical Co.

Brass & Copper Corrosion (O). Corrosive effect of water on brass pipe and copper tubing can be minimized by following procedures described in 2-page folder. Water Service Laboratories Inc.

Chemical Feeders (P). Features such as high accuracy, extremely wide range and dust-proof operation are discussed in 12-page bulletin. Diagrams show how automatic proportional control may be obtained. Typical arrangements and installations are given. Special applications and data on computing dissolving chamber capacities for the feeders are included, as are specifications and dimensions. Omega Machine Co.

Water Conditioning (Q). Engineers who have long sought the remedies for scale, corrosion and algae will find this 12-page colorful booklet of real value. Presents a highly technical subject in a non-technical manner. Shows how scale develops, corrosion is aggravated, and the growth of algae is promoted. Describes the treatments needed to control attacks of water impurities. Aquatrol, Inc.

Water Treatment Guidebook (R). Illustrated 12-page booklet, which serves as a guide, covers the complete scope of water treatment. Explains why various water troubles occur. Also tells what types of treatment are required to prevent scale formation, corrosion, foaming and embrittlement. Covers supplementary treatments for lime-soda softened, zeolite softened, and deionized water. Elgin Softener Corp.

Mixing & Agitation (S). Technical chart in graph form will assist engineers and operating personnel in quickly checking power requirements for liquid agitation of most types. Another bulletin features custom built mixing and agitating equipment in designs that give practical solutions to liquid, semi-plastic and dry powder mixing problems. Process Industries Engineers, Inc.

ELECTRICAL EQUIPMENT

Synchronous Condensers (T). Proper use of synchronous condensers re-

(Continued on page 28)

—ONE JOHN ZINK JZ STOP—
BURNER SERVICE

THERE'S A JOHN ZINK BURNER FOR EVERY HEATING and POWER NEED

John Zink and his engineers manufacture more than FIFTY TYPES of gas burners, oil burners and combination burners for domestic boilers, heating boilers, industrial boilers and power boilers. The designs are protected by TWENTY United States Letters of Patent.

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Bi-Mix Short Flame Burners for Floor and Wall Firing, Combination Gas and Oil Burners, Low Pressure Multi-Jet Bi-Air Burners, Low Pressure Heating Burners, Domestic Burners, Acid Sludge Burners, Round Flame Steam Atomizing Oil Burners, STRAIGHTENING VANES—Tubular Type, Cast Iron Wing Type, Depot Stove Burners, Unit Heaters, Air Heaters, JOHN ZINK FLOOR FURNACES.

COMBINATION GAS & OIL BURNERS FOR EITHER VERTICAL or HORIZONTAL FIRING

SERIES CBM

Full rating may be taken with completely satisfactory fires with either fuel.

Both fuels may be fired in combination if necessary.

A new file and register design permits operation at low excess air.

Any gaseous fuel at pressure in excess of 5 lbs. may be burned.

Any commercial grade of fuel oil may be burned when properly prepared.

CBM

SERIES Y & SERIES YC

John Zink Series Y and YC Combination Gas and Oil Burners are particularly designed for boilers and process furnaces where maximum heat release at low excess air and high heat density place a premium on reliable burner performance at low first cost.

MAXIMUM DUTY — MINIMUM DRAFT.

RUGGED WEATHER-PROOF CONSTRUCTION.

SIMPLE IN DESIGN.

LIGHT-WEIGHT FUEL GUNS ARE EASY TO REMOVE.

BURN ANY COMMERCIAL FUEL OIL.

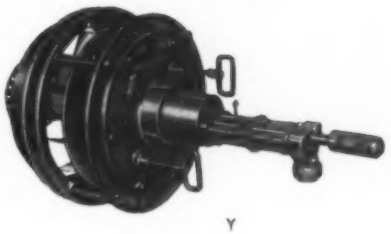
BURN ANY GAS AT REASONABLE PRESSURE.

DRAFT MAY BE NATURAL, INDUCED OR FORCED.

CHROMIUM ALLOY STEELS FOR HEAT & CORROSION RESISTANCE.

CENTER FIRING WITH BOTH FUELS ASSURES EQUALLY SATISFACTORY OPERATION WITH EITHER FUEL.

ANY AIR TEMPERATURE MAY BE USED.



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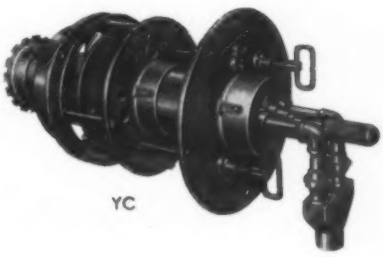

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WRITE FOR LITERATURE

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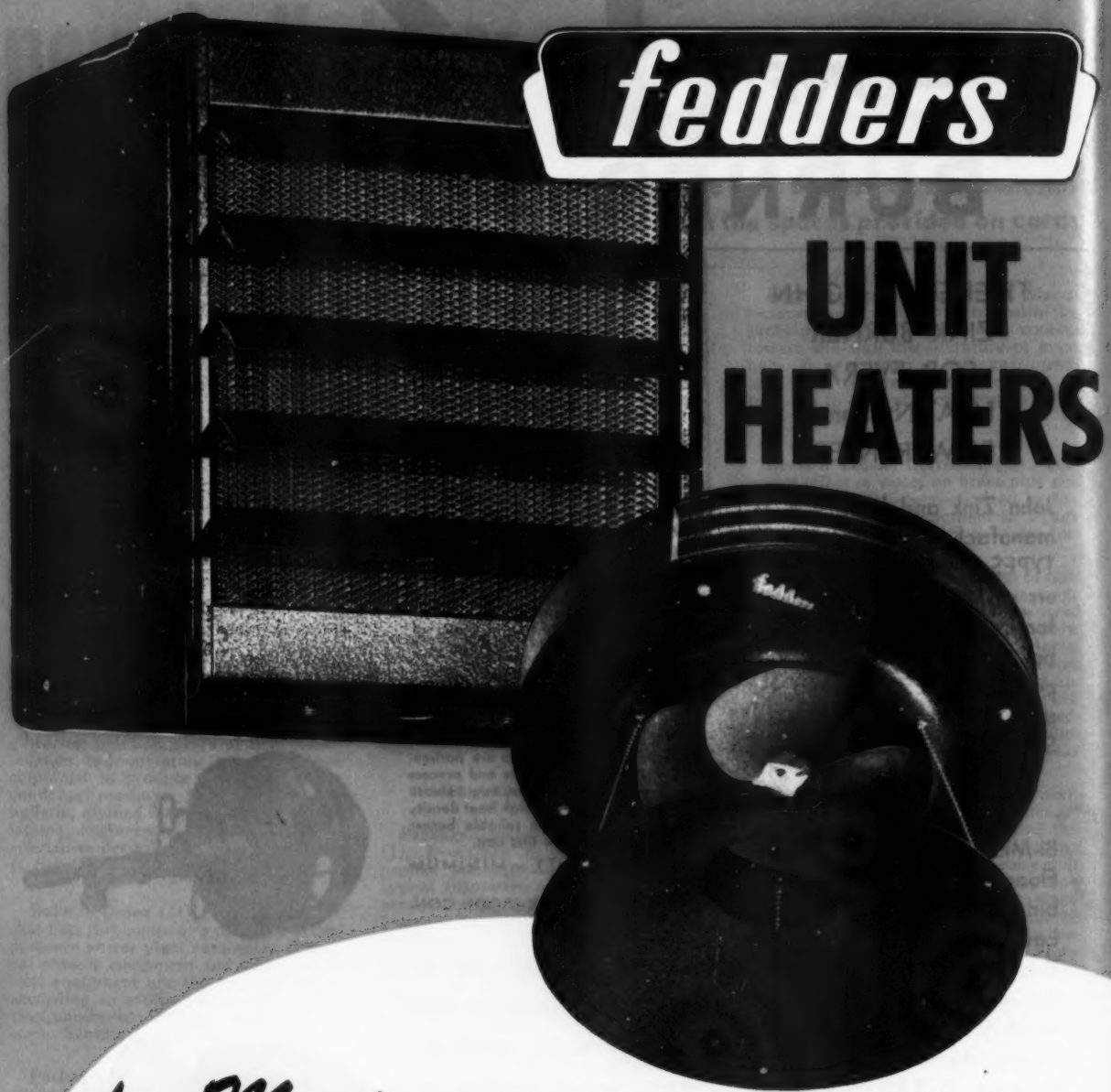


UNIT HEATERS

for Maximum Output with Minimum Cost

Fedders advanced design and high efficiency provide the most economical heating unit from every standpoint of easy installation, quick response to manual or thermostatic control and fuel savings. Made in a complete range of well-graduated sizes in horizontal and downblow types.

Write for name of your local representative.

FEDDERS-QUIGAN CORPORATION

BUFFALO 7, N. Y.

3 GOOD WAYS TO Stop Wasting Water

1 Make *raw* water fit for industrial use by *straining* it.

If you're in a scarce-water community, save water and cut your water bill—use a Cuno FLO-KLEAN strainer to remove trash from river or lake water. Its permanent wire-wound cartridge positively removes all solids larger than specified*, with negligible drop in pressure.

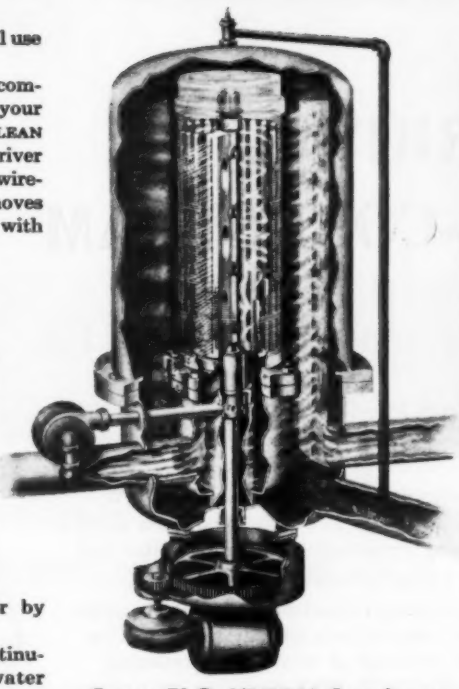
2 Reclaim and recirculate *used* water by *straining* it.

If you use water for process work, lower your water and water-heating costs—clean out contaminating solids with a Cuno FLO-KLEAN, and recirculate. Being continuously self-cleaning, it handles full flow—no expensive duplex installation needed.

3 Save valuable *backwash* water by using a FLO-KLEAN strainer.

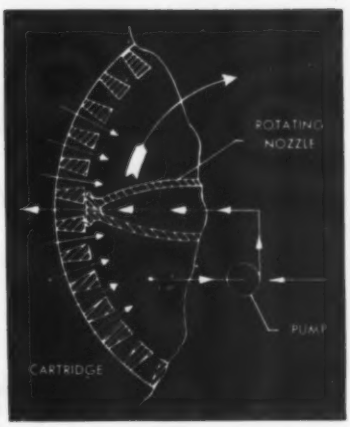
Only Cuno FLO-KLEAN is continuously self-cleaning without water waste. Used backwash is returned to the system. And—with automatic cartridge and automatic top and/or bottom blow-down—it can be installed in a remote place and virtually forgotten.

*Available spacings from .0025 to .020 in.



Cuno FLO-KLEAN Strainer

Permanent, abrasive and corrosion resistant.



Cuno's unique backwash system wastes no water.

FLO-KLEAN PAID FOR IN ONLY 6 MONTHS!

A bottling plant in a scarce-water area saved water and paid for its FLO-KLEAN in 6 months out of savings from making wash water reusable.

Find Out How to Save Money *cleaning any fluids containing abrasives*

No Fluid Is Better Than Its Filtration

CUNO

Complete Line Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (MICRO-KLEAN) DISC-TYPE (AUTO-KLEAN) WIRE-WOUND (FLO-KLEAN)

CUNO ENGINEERING CORPORATION
1410 South Vine St., Meriden, Conn.

Please send information—without obligation—on Cuno FLO-KLEAN for application noted:

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Name.....Title.....
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PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

NEW ARRIVAL IN LOW-COST STEAM

B&W Integral-Furnace Boiler, TYPE FM Shop Assembled... Ready to Use

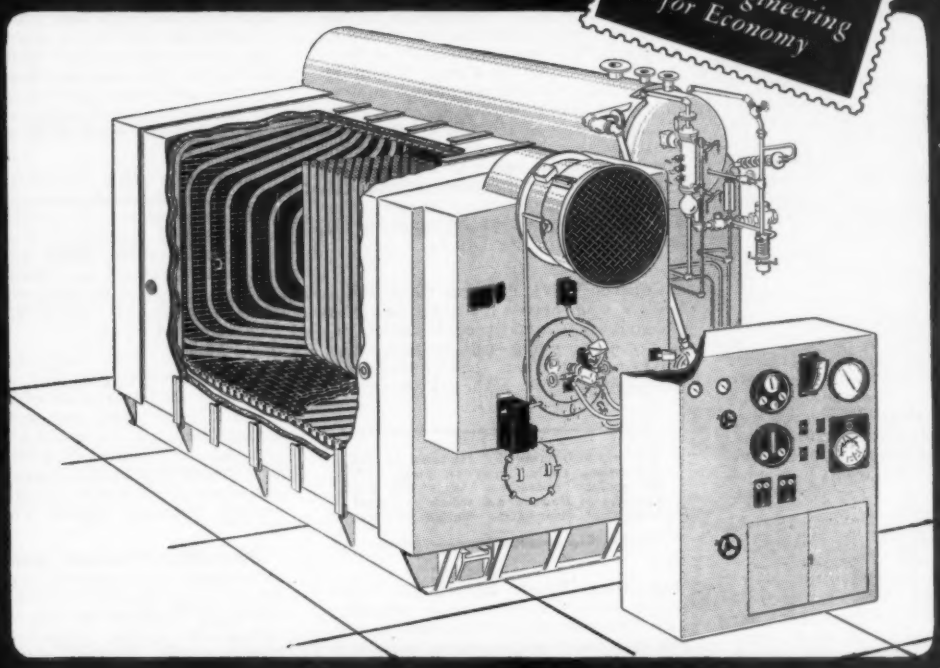
Latest addition to a distinguished family is the new B&W Integral-Furnace Boiler, Type FM . . . developed from B&W's seventeen years' pioneering experience combining boiler and water-cooled furnace in a single, integrated unit.

Formerly available only in large industrial and central-station designs, Integral-Furnace Boilers have already accounted for over 100 million pounds per hour of new steam-generating capacity since their introduction in 1933. And now their proved advantages are incorporated in a completely shop-assembled, self-contained unit.

Small and medium size plants, institutional and commercial establishments will find in this unit all the answers to low-cost heating and process steam-generating requirements from 3,000 to 35,000 lb. per hr. at pressures to 250 psi. Large plants, too—where space and load characteristics warrant—may profitably consider several packaged boilers as against a "tailor-made" installation.

A creative engineering approach to boiler design, as so strikingly exemplified by this new arrival in steam-generating economies, has identified B&W with steam-power progress for more than 80 years. It may be just what is needed to insure big economies in the solution of *your* present problems or future plans.

A Product of B&W Engineering for Economy



COST SAVING FEATURES

OF THE NEW B&W INTEGRAL-FURNACE BOILER, TYPE FM

- Saves Erection Time and Cost
- Meets Wide Range of Services
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

Send for Bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation.

The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

Helping Industry Cut Steam Costs Since 1867

G-505

(*Continued from page 22*)

sults in greater system efficiency and savings in power costs according to 16-page bulletin. Air-cooled, outdoor air-cooled and hydrogen-cooled condensers are completely covered. Auxiliaries such as exciters, starting autotransformers and starting motors are discussed. Allis-Chalmers Mfg. Co.

Sanitary Motor (U). Interesting 8-page, 4-color bulletin emphasizes the idea of improving shop and machine appearance by use of totally enclosed sanitary motors. Features include white baked enamel finish, flush exterior, adjustable mounting positions, sealed terminals, ratings from ½ to 7½ hp, rustproof fittings and asbestos protected windings. U. S. Electrical Motors, Inc.

Heavy-Duty Battery Charger (V). Unitized switchboard, consisting of motor-generator panel and one or more battery charging panels, charges two or more motive-power batteries at one time. Used for multiple-circuit battery charging of driver-ride electric trucks. Full information given in 2-page bulletin. The Hertner Electric Co.

Electric Cable (W). Devoted to steel reinforced, aluminum cable, 16-page, 3-color booklet describes the production of electric cable and pictures the equipment and operations. New development that cuts the cost of cable ½-cent per lb is shown in detail. Technical literature and consulting engineering service on cable are explained. Information is also given on aluminum substations. Reynolds Metals Co.

Inter-Lock Receptacle (X). Safe, spark-proof outlet receptacle has an automatic circuit breaker that breaks the circuit before cords can be disconnected. Folder shows pictures and prices. Panalarm Products, Inc.

INSTRUMENTS, CONTROLS, RECORDERS

Industrial Instruments (Y). Here are 56 pages of the latest information on temperature and pressure instruments. Catalog contains complete data on industrial thermometers, hydrometers, pressure gages and regulators, and other products. Photos and drawings illustrate all items. H. O. Trerice Co.

Level Controls (Z). Various models of level controls suitable for any liquid, featuring simplicity—no floats, maintenance-free—no tubes, safety—low voltage, are presented in 8-page bulletin. Illustrated with photographs, sketches, schematic drawings and cutaway views, the booklet thoroughly discusses the uses of level controls in industry. Photoswitch Inc.

Temperature Control Manual (2A). Intended as a contribution to the heating engineers library, this 24-page, 2-color manual sets down basic principles of industrial temperature control. Defines and evaluates different types of systems. Treats neglected subjects such as firing system influence upon control system design, fundamentals of mercury-bulb installation, and basic concepts of electrical and mechanical control theory. Typical circuits and piping along with ranges and calibrations of scales and dials are dealt with diagrammatically. The Partlow Corp.

Pneumatic Transmission System (2B). Pneumatic transmission as applied to control stations for recording pressure, flow and temperature is thoroughly described in 4-page illustrated data sheet. Advantages gained such as improved safety, higher speed, less installation and maintenance costs, and centralization of records are pointed out. Equipment required is listed, and a table showing the time lag for distances up to 2,000 ft is shown. Minneapolis-Honeywell Regulator Co. Brown Instruments Div.

Control Valve Packing (2C). "Teflon" V-ring plastic packing has been adopted as standard construction for this company's line of diaphragm motor valves. Read about this improvement in 4-page bulletin. Fisher Governor Co.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Electrical Power Record (2D). Increase your central station efficiency with this system that provides a continuous power output record of individual generators, the station, and the system total. Methods for accurate and rapid measurement of useful power with a check on reactive power to prevent overloading of generators are described in 4-page data sheet. Photographs and diagrams of the instruments required are shown. Minneapolis-Honeywell Regulator Co., Brown Instruments Div.

Insulation Resistance Tester (2E). No cranking or leveling required with this portable, self-contained instrument; just push a button and read your test result. Full data on 29 models having ranges from 100 to 50,000 megohms with test potentials from 125 to 1000 v d-c are given in 4-page illustrated bulletin. Associated Research, Inc.

Solenoid Valves (2F). Engineers with flow control problems will welcome this 72-page catalog. Consisting of ten sections, it thoroughly covers the subject of solenoid-operated valves of all types including explosion proof units. Well illustrated and supplemented with engineering tables. Specially bound in heavy permanent covers. Automatic Switch Co.

Speed Control Valves (2G). Illustrated with cutaway views, this 4-page bulletin shows features of new precision speed control valves with micrometer graduations. For air, water or oil control with pressure to 250 psi and temperature to 250 F. Specifications are included. Hanna Engineering Works.

Air Locks (2H). Air locks and trip master controls for holding regulating and control valves in position during failure of air supply are fully described in 2-page bulletin. Illustrated with photographs, diagrams and line drawings. Applications for various types of controls are shown. The Swartwout Co.

Thermocouples (2J). Industrial thermocouples and related accessories designed to save time and provide closer temperature control are covered in 16-page illustrated catalog. Handy tables giving material, size, construction, composition and recommended applications are included. For all makes of pyrometers. Arklay S. Richards Co., Inc.

Regulators (2K). Useful information about pilot-operated pressure and temperature regulators is contained in 32-page booklet illustrated with photos, charts and tables. Main valves, controls and strainers are discussed. Capacity and flow data along with dimensions and weights are given. Spence Engineering Co., Inc.

Liquid Level Gages (2L). Gages and valves for the observation of liquids and levels are pictured and described in 4-page bulletin. General information and features of standard, process, steam and special application gages and gage valves are given, and accessories are described. Jerguson Gage & Valve Co.

Electronic Polarized Relay (2M). Data sheet gives information on construction, operation, and installation of this relay designed for use in self-balancing a-c circuits. Applicable in remote controls. Barber-Colman Co.

Control Valves (2N). Certain faults in small valves used for metering, instrument lines and sampling have been eliminated completely says this 4-page bulletin. Describes features of this corrosion-resistant valve. Some of them are molded renewable Teflon seats, outside stem threads, and union bonnet construction. Alloy Steel Products Co.

Miniature Speed Changers (2P). The perfect solution to fixed ratio gearing problems in instruments, servomechanisms, controls, regulators, etc. That's what this 4-page bulletin reports. They have higher ratios, precision gears and zero backlash. Available in hundreds of standard ratios from 10/9 to 531,440/1. Metron Instrument Co.

Synchronous Motor Starters (2Q). Westinghouse has a control for operating and protecting all types of synchronous motor drives. Let them describe the mechanism for you in an 8-page book. Westinghouse Electric Corp.

Liquid Rheostat (2R). Provides stepless, wide range speed control of wound rotor motors; especially desirable for variable torque loads such as fan, blower and compressor drives. Leaflet says the rheostat is safe, compact, and gives full resistance range in 10-in. travel. Allis-Chalmers Mfg. Co.

MATERIAL HANDLING

Mobile Swing-Boom Crane (2S). In-

(*Continued on page 30*)

Look...compare...these **PREFERRED**

25-YEAR FEATURES* *at the Power Show*

SEE WHY ONLY PREFERRED OFFERS ALL 8!

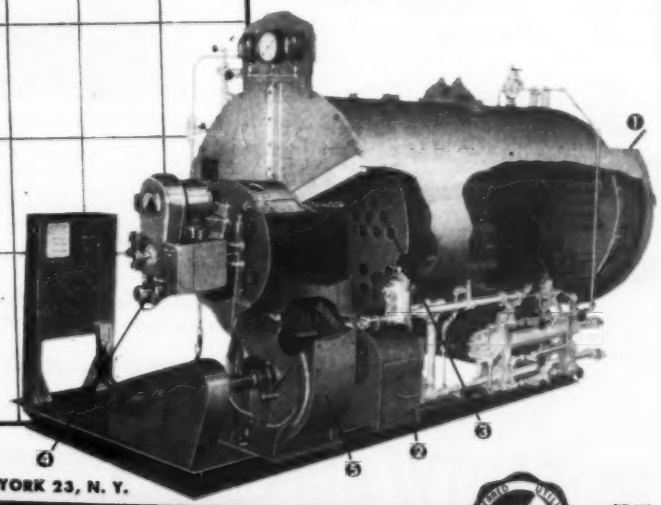
FEATURES	PREFERRED BOILER	BOILER A	BOILER B	BOILER C
❶ Anti-stress deck for tube sheet protection.	✓			
❷ Special *precipitator* developed by Preferred as aid to safe, clean operation.	✓			
❸ Staggered tube construction—minimizes possibility of tube pitting, even at *low* firing rates.	✓			
❹ 4700 rpm horizontal rotary oil burner with patented VOLUVALVE fuel regulation—designed and manufactured by Preferred—assures fully automatic operation even with No. 6 oil.	✓			
❺ Self-cleaning *induced draft* fan with air cooled shaft and bearings—assures long life	✓			
❻ Down-draft gas travel for 80% thermal efficiency—proved and guaranteed.	✓			
❼ Dual purging cycles for positive elimination of gas stratification.	✓			
❽ 4-pass, high velocity, gas travel—minimizes tube cleaning maintenance by self-cleaning action.	✓			

FIRST STOP FOR COMPARISON
PREFERRED'S
BOOTHS 60 & 61

*

Each distinctive feature of the Preferred Unit Steam Generator is designed to give efficient, economical service for an average of 25 years, with proper care and maintenance. You benefit by better performance . . . longer life . . . lower boiler costs.

If you are not able to attend the Power Show, be sure to get all the facts on the Preferred Unit Steam Generator. Send today for Bulletin 1000.

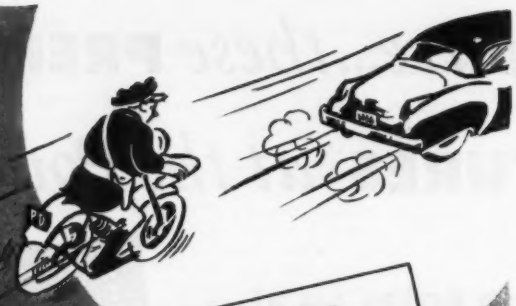


PREFERRED UTILITIES MFG. CORP., 1860 BROADWAY, NEW YORK 23, N. Y.

PREFERRED UTILITIES MFG. CORP.

PR-108

What Other Drive Gives You...



1 ACCURATE SPEED CONTROL

Holding precise speed without hunting ...idling at low speed without stalling ...two unique advantages provided by Troy-Engberg Steam Engines.

Troy-Engberg Steam Engines provide infinitely variable speeds over extremely wide speed ranges with the fully enclosed, ball-bearing, self-lubricating Type EN Governor maintaining the set speed accurately despite wide fluctuations in load and steam conditions. This precision governor displays a virtually straight line setting-vs.-speed characteristic that well adapts it to automatic control.

We ask again, what other drive gives you Accurate Speed Control?

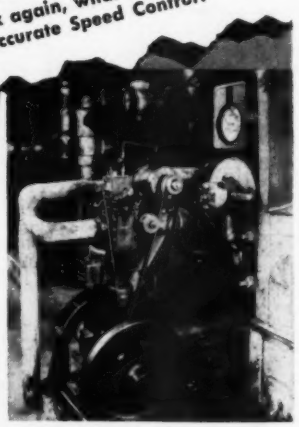
Plus

2 BY-PRODUCT POWER

3 FULL-LOAD STARTING

4 UTMOST FLEXIBILITY

5 SIMPLICITY, LONG LIFE



Straight and Sure: Under the control of a fully enclosed, self-lubricating Type EN Governor, this Troy-Engberg Steam Engine installation achieves almost perfect straight line relationship between engine r.p.m. and travel of the Republic flow meter piston. Result is accurate regulation throughout the range, without hunting or stalling.

WHICH DO YOU NEED?

If your drive needs any or all of these five values, the *modern* Troy-Engberg Steam Engine is indicated. Our engineers will be glad to recommend the right type and size to meet your particular requirements.

EXHIBITED IN BOOTH 88 — POWER SHOW

Send for Engine Bulletin 306 and Governor Bulletin 502

TROY

Troy Engine & Machine Co.

Power Equipment Division

1205 RAILROAD AVENUE • TROY, PENNSYLVANIA

(Continued from page 28)

doors or out, this crane will prove its usefulness. Collection of on-the-job photos shows the versatility and mobility of the Krane-Kar. Available in sizes from 1½ to 10 ton capacity according to 6-page folder. Silent Hoist & Crane Co., Inc.

Hoists (2T). Be air-wise—move your materials along clear pathways with Hi-Lift hoists and hoist cranes. Illustrated 8-page booklet shows typical installation photos together with close-up and sub-assembly views. Tabulated dimension and capacity data for the various types are included. Northern Engineering Works.

Elevators (2U). This 24-page bulletin will help you solve any vertical transportation problems. Contains tables of recommended sizes, drawings showing shaft dimensions required, and general data on heavy-duty elevators. Otis Elevator Co.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Elevator Wire Rope (2V). Keep this 26-page bulletin on hand to aid in elevator rope maintenance. Installation, maintenance, inspection and removal of elevator ropes are all given detailed treatment. Series of charts and pictures show how to determine the percentage of remaining strength in worn rope. John A. Roebling's Sons Co.

Neoprene Belting (2W). Catalog section claims brown or white Supertex belting is ideal for almost every type of light conveying and transmission service. The two pages give complete details on applications, construction and specifications. Baldwin Belting, Inc.

POWER TRANSMISSION

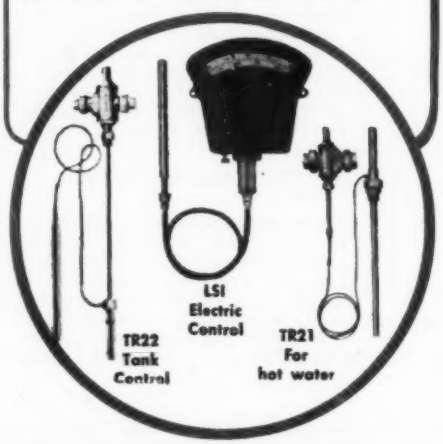
Gear Drives (2X). Choosing a drive is made easy by the selection tables in this 16-page bulletin. Also announces a newly developed packaged power unit consisting of a compact, enclosed helical gear drive with separate standard motor, flexibly coupled and mounted on one welded-steel base plate. Series of application photos and dimensional data along with the latest price list are included. Link-Belt Co.

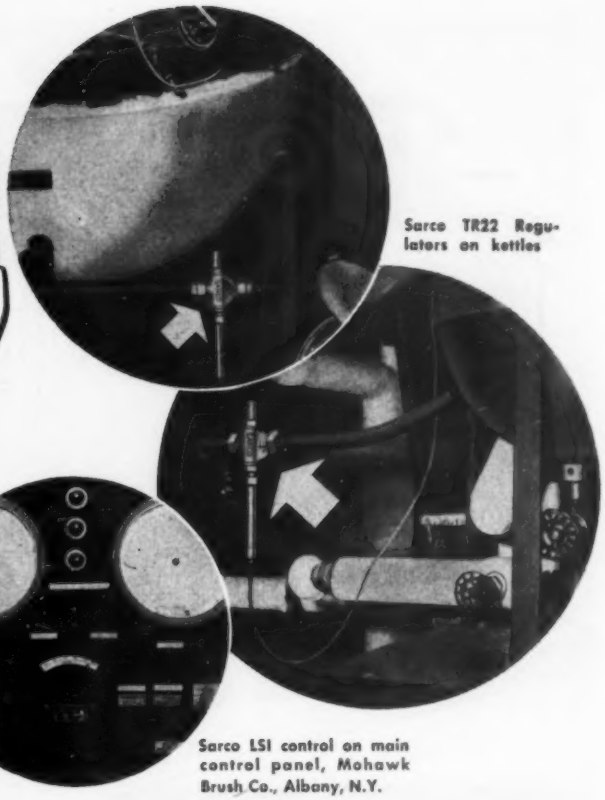
Speed Reducers (2Y). Improved parallel-shaft speed reducer and a right-angle unit (both horizontal and vertical), designed for a wide variety of power transmission requirements, are illustrated and described in four engineering bulletins. These 24-page booklets furnish complete information on selection, ratings, service factors, dimensions, etc. The Falk Corp.

Worm Gear Reducers (2Z). Worm gear speed reducers with several engineering improvements are described in

(Continued on page 32)

"BOSS, I'M NO JUGGLER, BUT I KNOW SARCO CAN DO THE TRICK"





Sarco TR22 Regulators on kettles

Sarco LSI control on main control panel, Mohawk Brush Co., Albany, N.Y.

The operator of this mixing process was just plain smart when he told his boss that he couldn't juggle the five different temperatures which must be exact at all times for successful production.

Sarco did the trick. Each of the ingredient kettles now has a Sarco TR22 regulator on the steam supply. Two tanks have a Sarco LSI electric indicating control, one of which is shown on the main control panel above, and the final mixing tank is held at exactly 212° with another Sarco.

The result is increased output because no time is lost, and repeat performance is insured. Of course, the combined operation uses less steam because none is wasted.

WHEREVER TEMPERATURES COUNT — The process engineer can be the boss. He can specify the temperatures he wants — and know that is how the job will operate. Furthermore, if he wishes to change the process it would take only a minute to reset the regulators.

A few of the Sarco controls used for batch operations are shown at the left. If you have a temperature control problem, try Sarco first.

311

SARCO SAVES STEAM

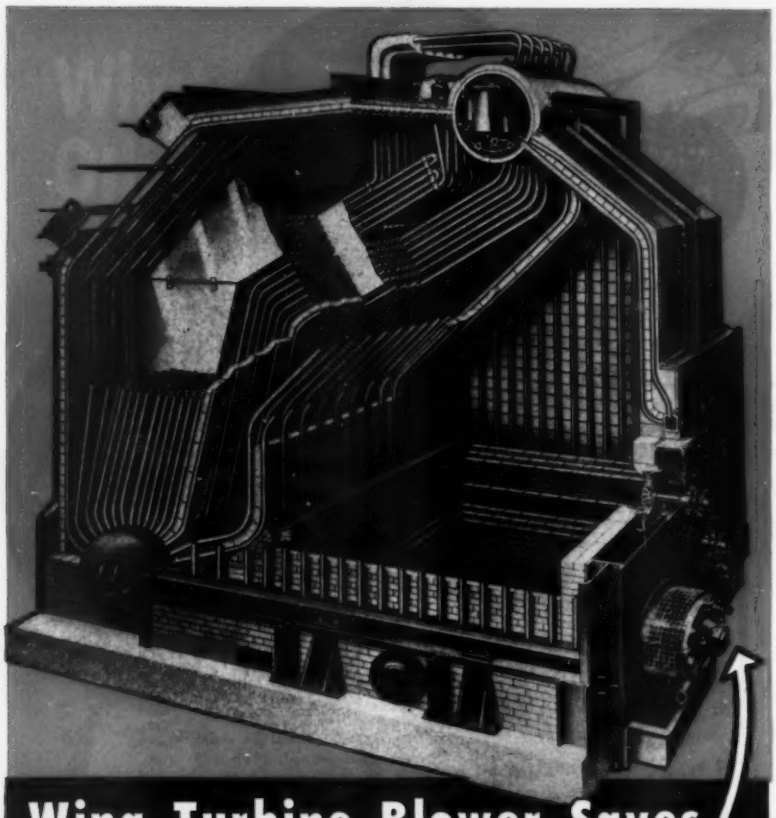
SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

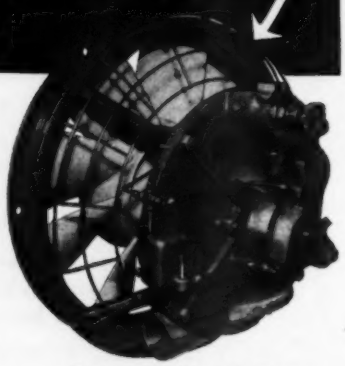
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT



Wing Turbine Blower Saves Floor Space, too

Besides furnishing forced draft with precise control, the Wing Turbine Blower contributes to the cost-saving features of the B & W Integral Furnace Boiler, illustrated above, by saving valuable floor space, avoiding duct work and large space requirements. It is also quiet and efficient in operation.



A copy of Wing Bulletin No. SW-50 on Wing Blowers and Turbines will be sent on request.

L. J. Wing Mfg. Co.
139 Vreeland Mills Road, Linden, N. J.

Wing

AXIAL FLOW BLOWERS

(Continued from page 30)

36-page bulletin. Horsepower rating tables, dimensional drawings, cutaway views showing face-type oil seals, and an efficiency curve together with coupling bore and shaft extension data comprise this factual booklet. The Cleveland Worm & Gear Co.

PUMPS AND ACCESSORIES

Centrifugal Pumps (3A). No lubrication, no stuffing box trouble, no repairs need be made in your plant; those are some of the advantages listed in 8-page illustrated bulletin. Others are stainless steel shafts and horizontally split cast iron casings. Service and Exchange Plan is explained, too. Sizes from 2½ to 4 in. for capacities to 400 gpm and heads to 230 ft. De Laval Steam Turbine Co.

Pump Selection Guide (3B). Centrifugal pumps in a wide variety are indexed in this 16-page "Handy Guide to Selection of Centrifugal Pumps". Head capacity charts, and tables for each type are given along with data on sizes, capacities and construction features. Allis-Chalmers Mfg. Co.

Multi-Stage Pumps (3C). For more than 75 years this company has been turning out pumps and has pioneered many innovations in the pump field. The Multiplex, a centrifugal multi-stage, split case, volute type pump which covers a range of head up to 2000 ft and capacities from 100 to 4000 gpm, is illustrated and described in 16 pages of photos, sectional drawings, charts and tables. Byron Jackson Co.

Centrifugal Pumps (3D). Ideally suited to any high pressure, low volume pumping job where high efficiency is desired. Illustrated 12-page booklet tells all about the Hydropress, a double case, double volute, multi-stage centrifugal pump. In sizes 10, 12, and 15 in. with capacities of 20 to 300 gpm. Another 8-page bulletin describes a smaller and less expensive version of the Hydropress. Called the Hydroplex, it works just as efficiently. Capacities from 10 to 140 gpm. Byron Jackson Co.

TOOLS AND SPECIALTIES

Industrial Machine Tools (3E). Complete assortment of power tools—53 machines, 246 models, over 1300 accessories—are listed in 60-page catalog. Discusses features and gives specifications of each machine. Application photos along with cutaway views round out the book. Delta Power Tool Div. Rockwell Mfg. Co.

Tungsten Carbide Tools (3F). Precision machine ground, solid tungsten carbide tools, such as rotary files, reamers, internal grinding tools, and boring bits that can be reground innumerable times are presented in 12-page, 2-color catalog. The Charles L. Jarvis Co.

Soldering Guns (3G). Helpful soldering information is contained in this il-

(Continued on page 136)

dag DISPERSIONS®

Products bearing the registered trademark **"dag"** originate only with the Acheson Colloids Corporation, Port Huron, Michigan, or with Acheson Colloids Ltd., London, England. Acheson Colloids is the world's largest producer of colloidal graphite dispersions for the metalworking and electronic industries, and also supplies dispersed pigments to a large segment of the color-consuming trade. The trade-marks "Oildag", "Aquadag", "Prodag", "Glydag", "Castordag", "Varnodag" and "Gredag" identify particular products of Acheson Colloids Corporation or its affiliates, and are duly registered in the United States and in other principal countries of the world.

L-17

dag DISPERSIONS

Acheson Colloids Corporation, Port Huron, Michigan

... also Acheson Colloids Limited, London, England

You Save on 4 Counts with ENCO STREAMLINED BAFFLES

1 Better heat transfer

Enco's improved baffle design insures a uniform, high velocity gas flow over every square foot of heating surface.

2 Low draft loss

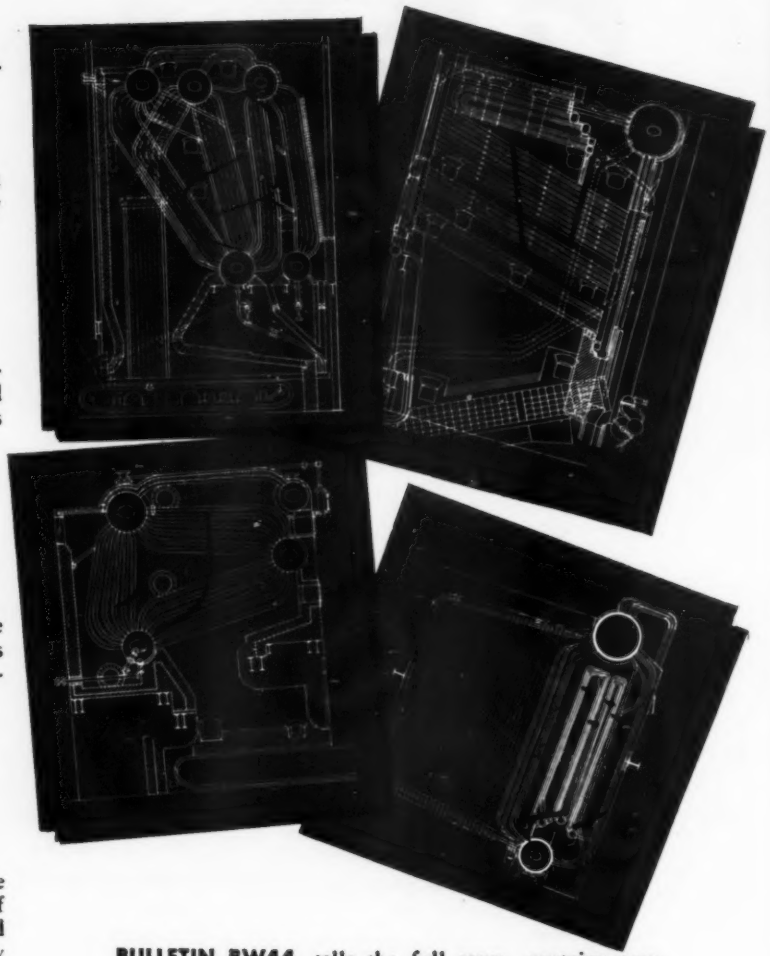
Smoothly curved baffles maintain a cross-flow of gases across the tube banks. Dead gas areas, bottlenecks and eddy currents are eliminated.

3 Less steam, less time for cleaning

Soot doesn't get a chance to accumulate in pockets. Soot blowers are used less often. Streamlined baffles lower maintenance costs.

4 Custom installation

Experienced Enco crews take charge of the installation, repairs and replacements of your individually designed streamlined baffles—do the job thoroughly and quickly with minimum downtime.



BULLETIN BW44 tells the full story, contains complete engineering data, explains how Enco Baffles provide maximum steam output with minimum fuel consumption. WRITE FOR YOUR FREE COPY TODAY!

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

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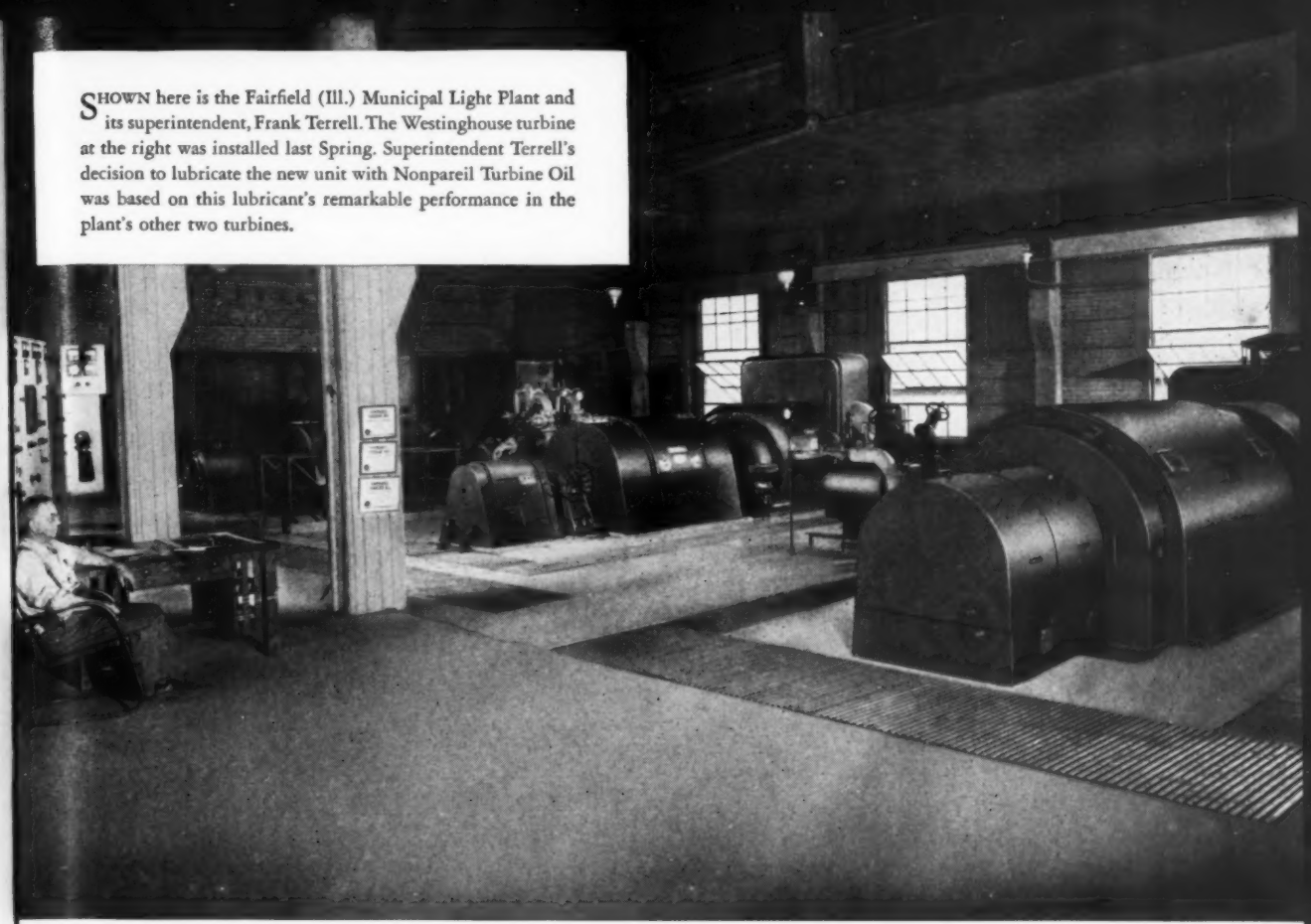


SHOWN here is the Fairfield (Ill.) Municipal Light Plant and its superintendent, Frank Terrell. The Westinghouse turbine at the right was installed last Spring. Superintendent Terrell's decision to lubricate the new unit with Nonpareil Turbine Oil was based on this lubricant's remarkable performance in the plant's other two turbines.

Here's <u>minimum</u> turbine-oil maintenance

CENTRIFUGING once a year is the only turbine-oil maintenance found necessary at the Fairfield Municipal Light Plant, Fairfield, Illinois. This practice has been followed ever since 1940, when Nonpareil Turbine Oil first went into the plant's new 1500-KW Westinghouse turbine. The same routine has been employed on a second Westinghouse unit of 2500 KW, installed in 1942.

During these 8 and 10 years of operation, the original fills of Nonpareil have not been removed either for treating or for replacing. Neutralization numbers have stayed below 0.08 mg KOH/gm. Oil systems have remained entirely clean.

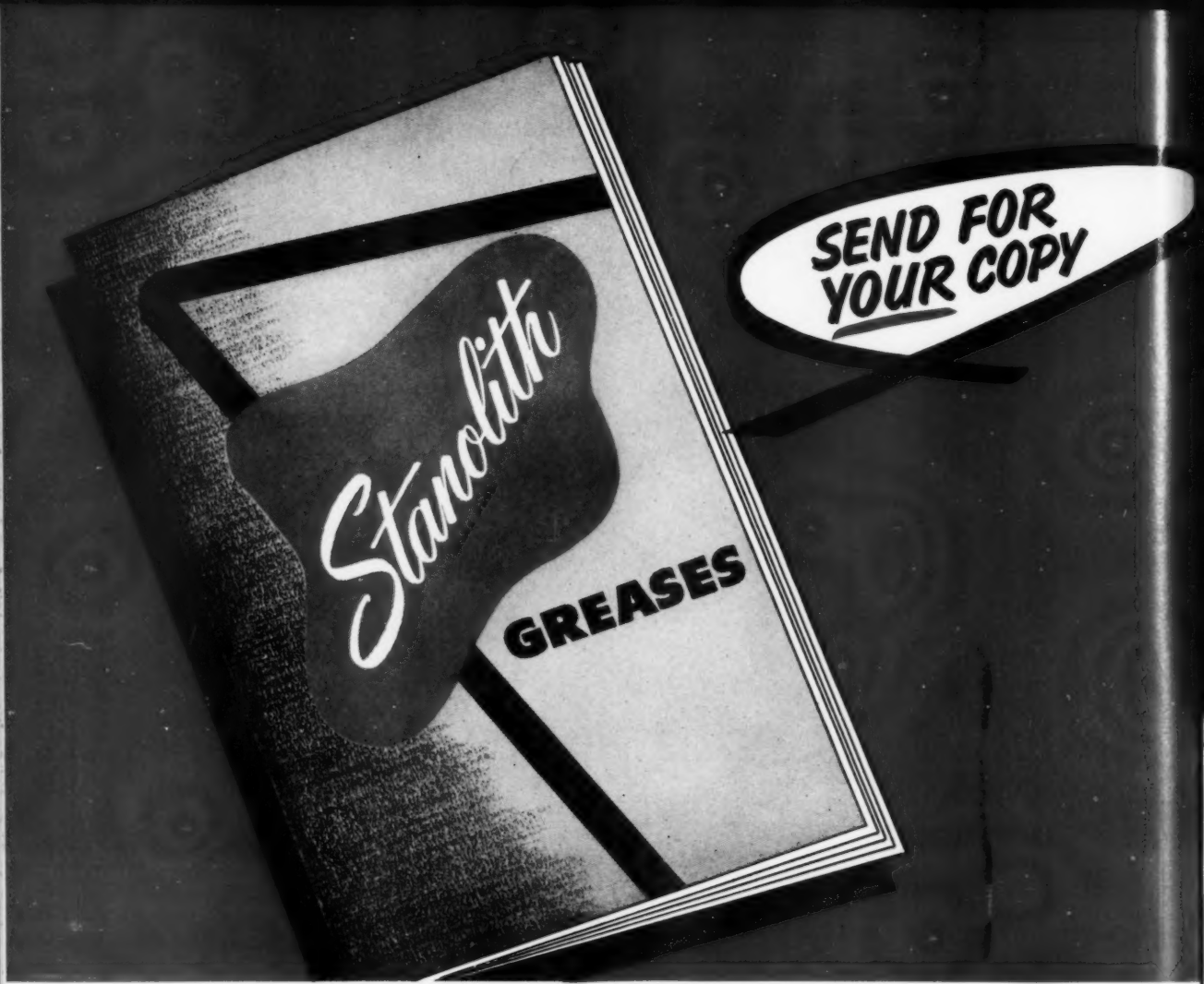
Such lubricating economy and efficiency is not limited to 10- or 15-year records with Nonpareil Turbine Oil. Each fill of Nonpareil carries a written guarantee that it will remain below a neutralization number of 0.15 mg KOH/gm. *for the life of the turbine* it lubricates. 21-year service records of Nonpareil provide evidence of its ability to end acidity trouble and oil maintenance once and for all.

A Standard Oil Lubrication Engineer will be glad to supply you with actual case histories of utility operations in which Nonpareil Turbine Oil has reduced lubrication costs as much as 68%. Your letter will obtain the Engineer's services.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY (INDIANA) STANDARD



Here's help for bearings in "HOT WATER"

New booklet tells how STANOLITH Greases solve wet-hot problems

HOW TO LUBRICATE bearings which operate under extremely wet conditions, and at the same time, are subjected to high temperatures? If that is one of your problems, the booklet illustrated above holds the solution.

It tells you about the outstanding qualities of Standard Oil's new STANOLITH Greases. It explains why these lithium soap products—unlike soda soap or lime soap greases—will withstand *both* heat and water. The booklet contains evidence of this ability. It gives actual case histories of some of the many different jobs on which STANOLITH Greases have eliminated troubles caused by high temperatures, presence of steam or water, and high speeds. It also describes successful low-temperature service.

Study this wide range of applications. Discover how the two grades of STANOLITH Grease not only can solve difficult lubrication problems but can save you the cost and trouble of stocking and using a variety of special greases. Send for this information. Write for your copy of the STANOLITH booklet today. Simply address your letter to:

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

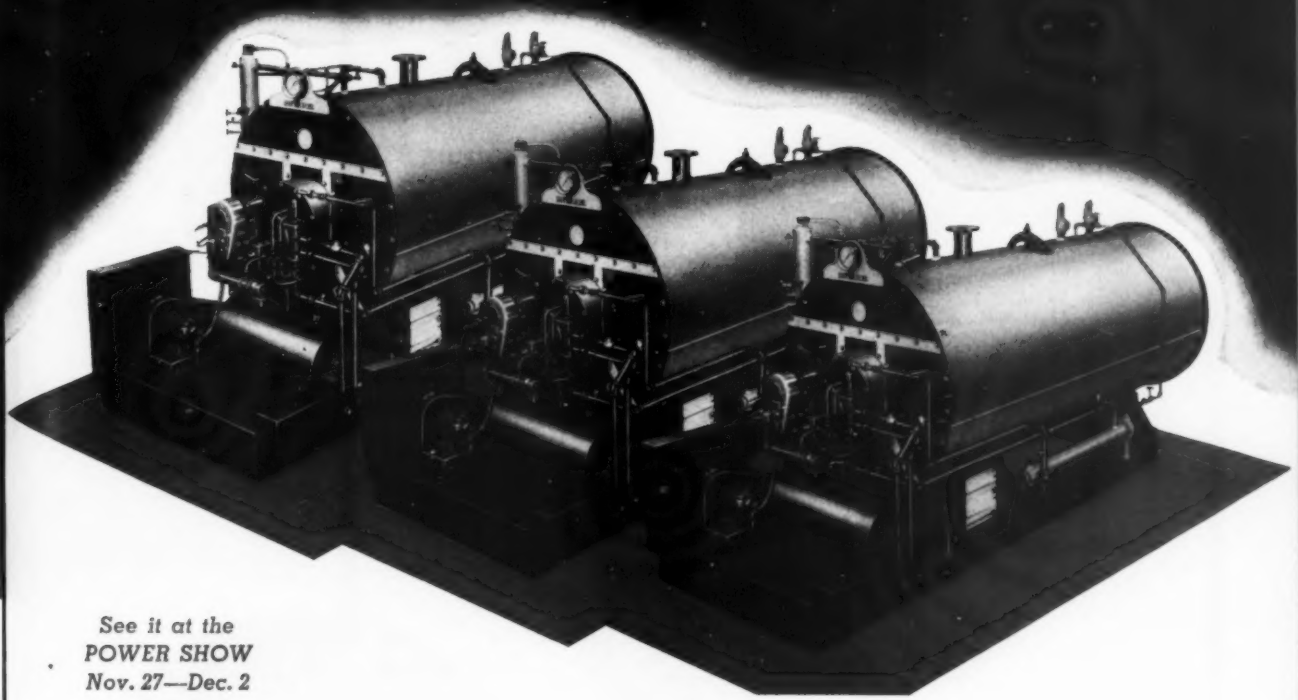
STANDARD OIL COMPANY (INDIANA

1+1+1=7

WHEN YOU'RE COUNTING

Superior

STEAM GENERATORS



See it at the
POWER SHOW
Nov. 27—Dec. 2

Battery installations of Superior Steam Generators provide extreme flexibility to meet the most widely fluctuating steam demands. A hospital installation illustrates the point.

From early June through September, steam demand is limited to the needs of hot water and sterilization. Any one of the three units carries this load with ease . . . and at higher efficiency than could be obtained by minimum operation of a larger boiler.

When cold weather adds its heating load, a second Superior Steam Generator is fired. Only the most severe weather demands firing the third unit . . . which throughout the rest of the year provides stand-by equipment which is desirable in any operation.

By employing different combinations of the three, (7 in all) allowing each unit in turn to share the load; all enjoy longer life at maximum efficiency . . . and by using only the number dictated by the steam demand, maximum economy at every stage of steam demand is assured.

Let us show you how battery installation can serve you better in your new plant . . . or augment your present steam facilities.

Write today for Catalog 202

uperior ombustion ndustries, inc.

Factory Emmaus, Pa.
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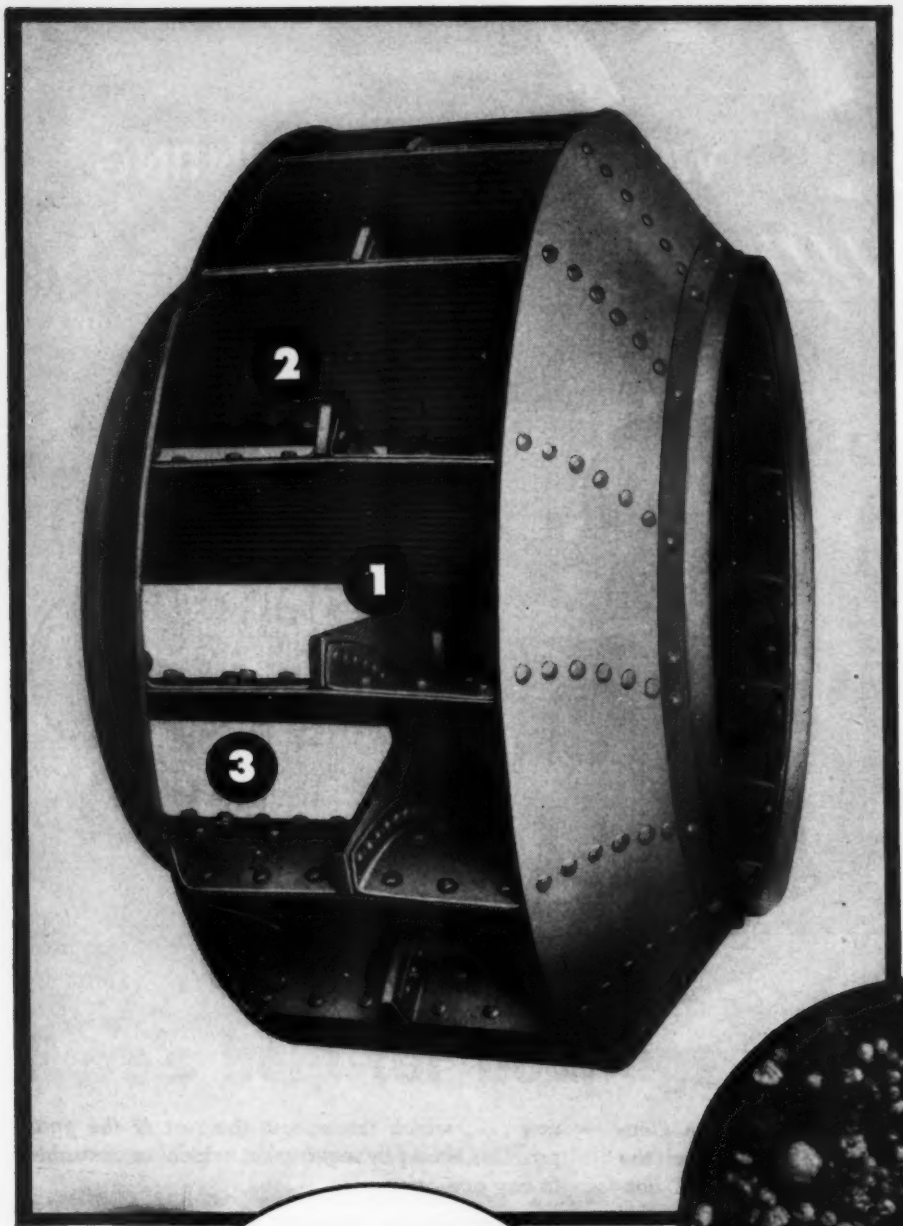
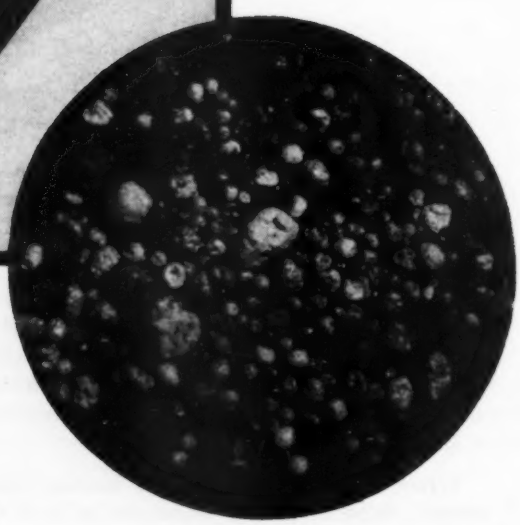
NO





Photomicrograph shows typical fly-ash resulting from the burning of pulverized fuel in a modern power plant. Fly-ash produced by stoker coal is similar in appearance.

Here's what fly-ash can do to a fan blade protected against erosion by hard-surfacing. Note how the surfacing has been undercut, and the metal of the blade itself attacked.

OTHER INDUCED DRAFT FAN MATCHES THE PERFORMANCE OF THE Sturtevant E-R WHEEL

Present-day high capacity ratings that increase fan-wheel abrasion by fly-ash also result in costly replacement, maintenance and down-time. But low maintenance and a minimum of time lost are possible with the Sturtevant Erosion Resistant Wheel. The proven, exclusive Sturtevant design causes the streams of fly-ash to attack each other, not the wheel surfaces, because the center plate is cut away (1) between the blades.

Special ribbed liners (2) armor the E-R Wheel against the abrasion of fly-ash. They can be easily and economically replaced on the job.

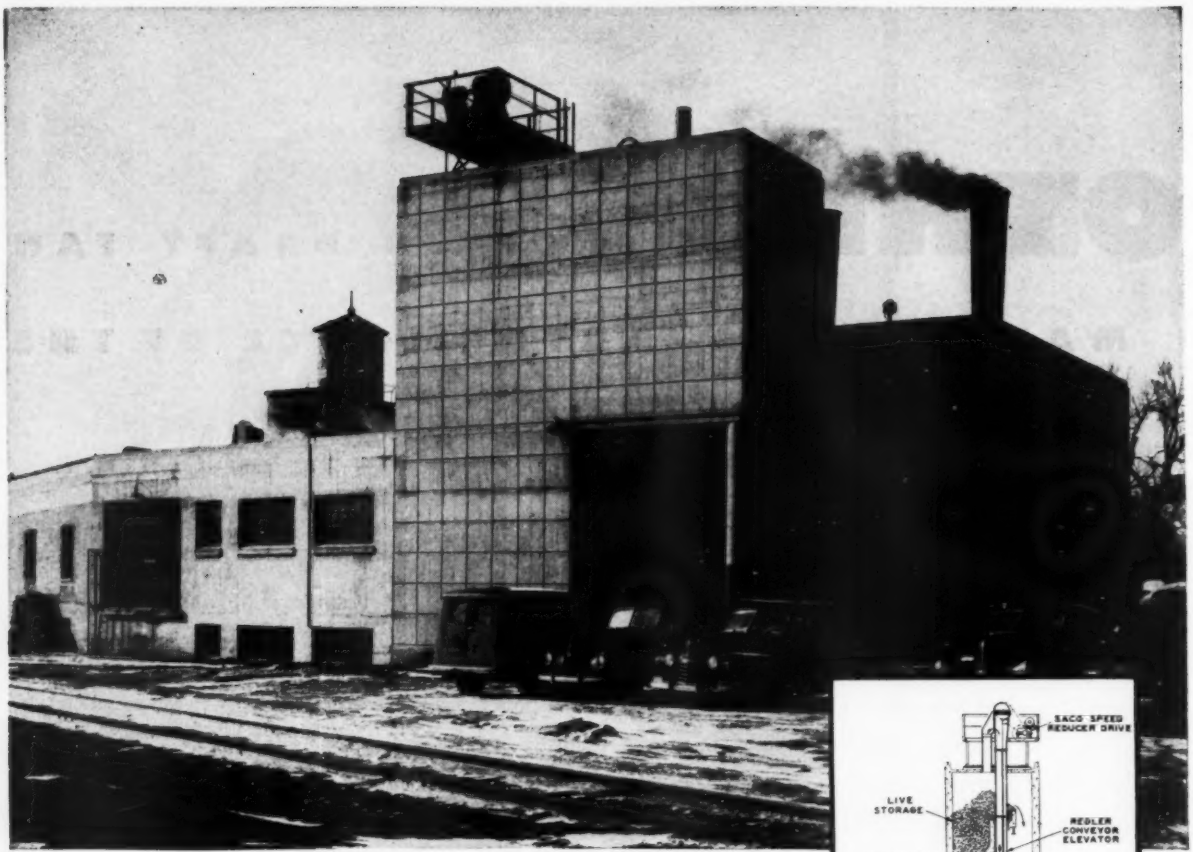
Fewer blades and the absence of tie-rods (3) mean less obstruction to the flow of fly-ash and less surface wear from eroding action.

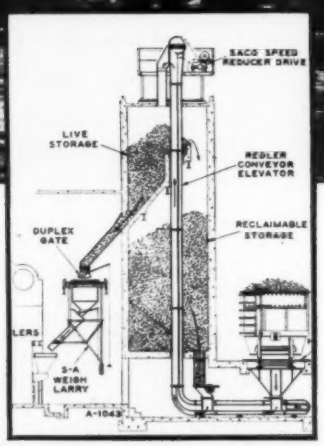
The Sturtevant E-R Wheel is the soundest investment you can make when considering induced draft equipment. You get this efficient wheel in Sturtevant Turbovane® Induced Draft Fans. It is possible that your present fan installation can be modernized with E-R Wheels. For full details contact your nearest Sturtevant Office, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

YOU CAN BE SURE...IF IT'S

Westinghouse

J-80205A





Coal Always Ready On the Shelf

...AND GOOD ARCHITECTURE, TOO!

At this modern food processing plant, one objective was to completely enclose coal handling in a compact, rectangular silo instead of in the more conventional round structure. S-A engineers achieved completely mechanized coal handling at low cost. A REDLER Conveyor-Elevator moves 20 tons an hour . . . "puts it on the shelf" ready for immediate use . . . or in nearby storage for quick reclaim (see drawing). Here's a modest size power plant where efficient operation and good architecture harmonize.

This unusual installation typifies the versatility and resourcefulness of S-A engineers in finding the best answers to specific problems of coal and ash handling. In talking over your needs with an S-A engineer, you are always assured that he is not biased in favor of a particular type of equipment. Stephens-Adamson makes *all* types . . . and, consequently, S-A engineers are free to recommend the unit or units best suited to your actual requirements. If you plan a new or remodelled conveying system, write us today . . . there is no obligation.

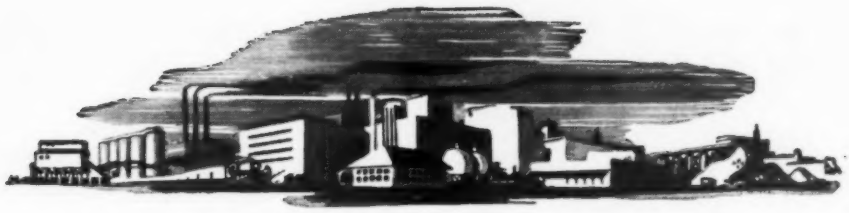
PETER ECKRICH & SONS
KALAMAZOO, MICHIGAN

Coal, delivered by rail cars to a track hopper, is fed to the lower horizontal run of a REDLER Conveyor-Elevator. Same conveyor curves into vertical run of casing and elevates coal 50 feet to live storage shelf inside and near top of silo. Coal then chutes from bottom of storage shelf into boiler room through duplex gate to a movable S-A Weigh Larry. The latter moves to discharge measured load to any one of several boiler stokers. When storage shelf is full, coal spills over and falls to bottom of silo. From there it is easily reclaimed through a chute which returns it to the REDLER Conveyor-Elevator.

STEPHENS-ADAMSON MFG. CO.

21 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif. • Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT



"We Added an Hour's Production Time Daily, *by Investing Just $2640!*"

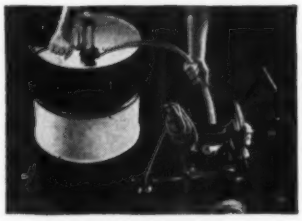
It happened in Philadelphia, in a plant* where ten machines with 560 bearings were being lubricated by old-fashioned methods that wasted valuable production time.

An Alemite Lubrication Engineer was consulted, to work with the plant engineers and help find a solution to this problem, an all-too-common one in industry today. A modern Alemite Centralized System was planned and installed, to lubricate all 560 bearings from a central point. Total cost—$2640. Lubrication time was cut from four man-hours to 10 minutes per week. A whole hour's production time was added to every working day, and the resulting added revenue paid for the entire project in just 66 days.

No matter what size or type of plant you operate, Alemite can show you dozens of ways to make worthwhile savings through more efficient handling of petroleum products. These are facts which you can readily confirm in your own time studies. Contact your local Alemite Industrial Distributor now. Or send for free booklet "11 Ways to Cut Production Costs." Simply attach coupon below to your letterhead. Alemite, Dept. M-110, 1850 Diversey Parkway, Chicago 14, Ill.

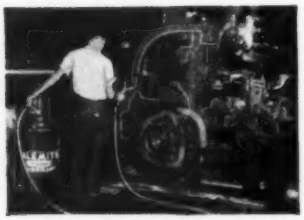
**Name on request*

Alemite Cuts Costs 3 Ways



1. ***In Transferring Lubricants...*** by eliminating mess, expensive contamination—and cutting man hours 63% for every 100 pounds of lubricant transferred.

2. ***In Loading Grease Guns . . .*** by saving 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.



3. ***In Applying Lubricants . . .*** by saving up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

ALEMITE

MEANS EVERYTHING FOR LUBRICATION

1. Methods 2. Lubricants 3. Equipment

Another Product of Stewart-Warner

FREE! New Booklet—
"11 Ways to Cut Production Costs"...
(simply attach to your letterhead)

Alemite, Dept. M-110
1850 Diversey Parkway, Chicago 14, Illinois

Please send me without charge or obligation your booklet "11 Ways to Cut Production Costs."

*Name*_____

*Company*_____

*City*_____ *State*_____

Quicker than it takes to tell it . . .

With the new Economy "DE-LAY" Renewable Fuse, you can replace the "blown" link in less time than it takes to tell it.

Almost before you can say "Presto-Change-O", you have made these three simple, quick, easy operations:

1. Unscrew end cap, twirl knife-blade assembly, take it out of fibre cartridge case.
2. Loosen nuts that hold "blown" renewal link, replace with new "DE-LAY" link and tighten nuts.
3. Replace knife-blade assembly and screw on end cap.

Only one way to make renewal—*the right way*, the fast way—and the Economy "DE-LAY" Fuse is ready to place back in the circuit.

Replace with Economy "DE-LAY" Renewal Links. They give maximum protection in the 135 to 200% load range where most "blows" occur.

ECONOMY DE-LAY RENEWABLE CARTRIDGE FUSES

2321R

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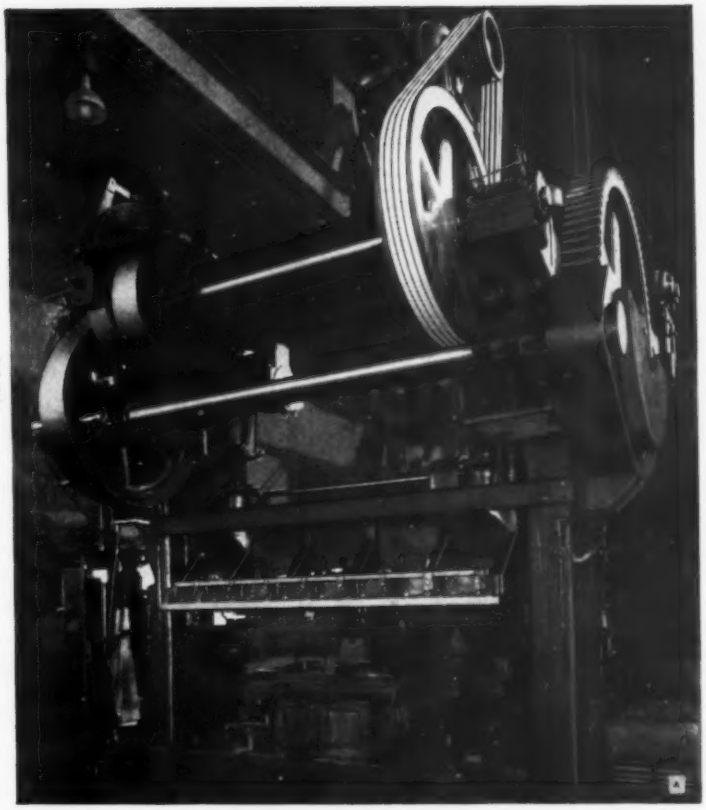
You are invited to write for the New Economy Catalog

ECONOMY FUSE AND MFG. CO., 2717 GREENVIEW AVE., CHICAGO 14, ILLINOIS REPRESENTATIVES IN ALL PRINCIPAL CITIES

Gates

REG U S PAT OFF

The Mark of SPECIALIZED Research



The output of this press was seriously bottlenecked by slipping of the short center flat belt with which it was formerly equipped. The Gates Vulco Rope Drive shown has completely overcome the difficulty. The original belts, after more than 4½ years of service, are still going strong.

Let this simple test tell you exactly WHY the Concave Side cuts your V-Belt costs

To see for yourself the belt-saving importance of the Concave Side, just pick up *any* V-belt and bend it as it bends when it goes around a pulley.

As the belt bends, grip its *sides* firmly with your fingers. You will feel the sides of the belt *change shape.* This is because the top of the belt is under tension and, hence, grows *narrower* while the body, under compression, *bulges out.* (See figure 1 and 1-A)

Now look at figures 2 and 2-A. There you see how the bending changes the shape of the belt that is built with the Concave Side —The Gates Vulco Rope. The concave sides of this belt merely *fill out* and become perfectly *straight.* There is no side-bulge. This belt, when bent, *precisely fits its sheave groove.*

A very distinct saving in belt wear results. No side-bulge means that the sides press *evenly* against the V pulley and therefore wear *uniformly*—resulting in longer life for the sidewall and, naturally, *longer life for the belt!*

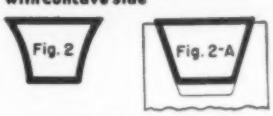
If you care about cutting your belt costs, it will pay you to make sure, whenever you buy V-Belts, that you get the V-Belt with the Concave Sides...the Gates Vulco Rope!

What Happens When a V-Belt Bends

Straight-Sided V-Belt

How Straight-Sided V-Belt Bulges in Sheave-Groove. Sides Press Unevenly Against V-Pulley Causing Extra Wear at Point Shown by Arrows.

Gates Vulco Rope with Concave Side



The Concave Side Fills Out to a Precise Fit in the Sheave Groove. No Side Bulge! Sides Press Evenly Against the V-Pulley—Uniform Wear—Longer Life!

CS-508

THE GATES RUBBER COMPANY
DENVER, U.S.A.
World's Largest Makers of V-Belts

GATES VULCO ROPE DRIVES
Engineering Offices and Jobber Stocks IN ALL INDUSTRIAL CENTERS of the U.S. and 71 Foreign Countries

We're not out to corner the DAMPER MARKET...

. . . we want HEACON DAMPER applications that will pay for themselves in 6 months.

The Heacon Damper is not just *another* damper. It is designed and engineered to provide the tightest closure possible under all conditions. Each damper is developed to solve a specific problem, each provides the ultimate in control.

The dampers shown on this page all solved specific problems that could have been solved in no other way.

As an example, the second damper from the left above, not only controls 80" w.g. pressure, but also acts as an automatic reverse flow valve that instantly closes and prevents leakage should one of two fans on the boiler fail. The next damper on the right isolates its air heater for maintenance while the boiler continues in service. Such applications save many times their cost, in time and power loss.

Call or write the office nearest you for full details.

THE THERMIX CORPORATION
GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD.,
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fireye Flame Failure Protection

At the Massachusetts Institute of Technology, where research is the order of the day, Fireye Flame Failure Safeguards were chosen to guard the boilers in the main power plant . . . chosen by engineers trained in modern industrial research . . . chosen to insure the uninterrupted research which guards our nation's security.

Fireye Flame Failure Safeguards have set new standards of safety for industrial gas and oil burning boilers. Get the whole story. Write today for Bulletin 604-C.

fireye

COMBUSTION CONTROL CORP.

77 BROADWAY, CAMBRIDGE 42, MASS

"For high dust collection efficiency CONSIDER THESE FACTS!"

95% to 99% REMOVAL

Your specific needs determine the exact percentage of fly ash removed by a Research Corporation Cottrell Precipitator.

LOW DRAFT LOSS

The pressure drop between inlet and outlet of the Cottrell is extremely low, averaging *only a few tenths of an inch of water.*

DURABILITY

Low velocities hold abrasion to a minimum.

ANY CAPACITY

Cottrell precipitators have been used successfully with both small boilers and the very large boilers developed in recent years.

OTHER APPLICATIONS

Cottrell precipitators have wide application in the recovery of other materials such as acid mist, blast furnace dust, sodium salts, fluid catalyst and valuable metals from smelters.

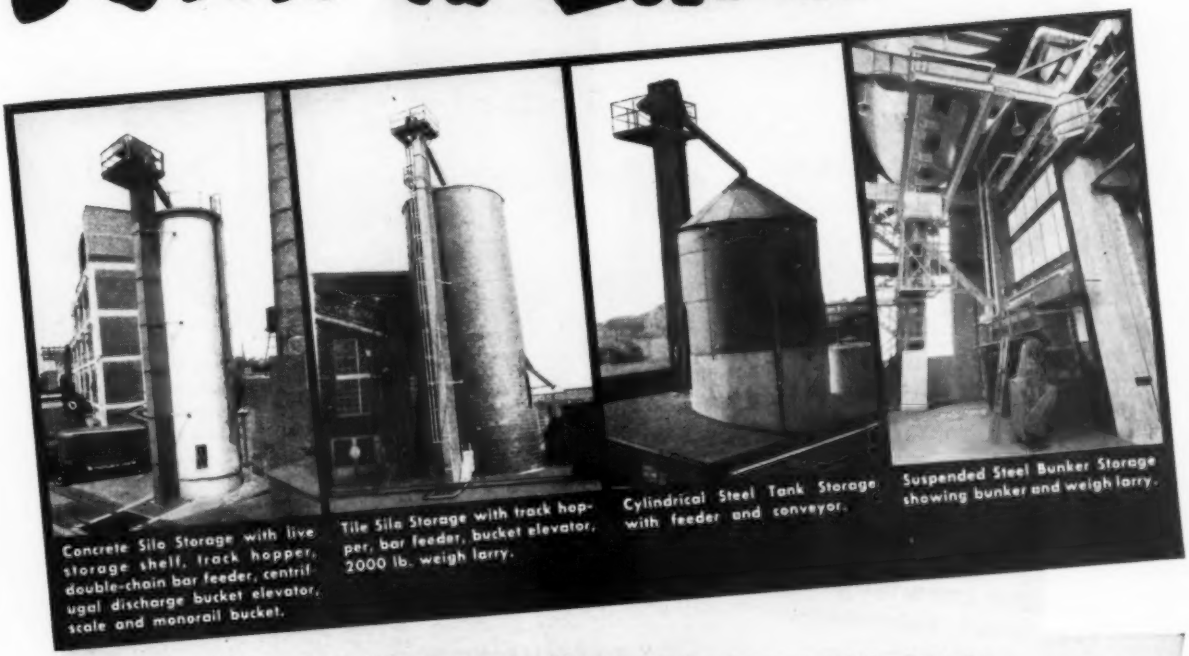
YOU GET all these important advantages PLUS Research Corporation's 38 years of experience in the field of electrical precipitation. Every Cottrell installation is individually engineered to do the most efficient job. For more facts about Research-installed Cottrells, send for Bulletin 500.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

BRINGING YOUR
COAL HANDLING COSTS

Down to Earth



Concrete Silo Storage with live storage shelf, track hopper, double-chain bar feeder, centrifugal discharge bucket elevator, scale and monorail bucket.

Tile Silo Storage with track hopper, bar feeder, bucket elevator, 2000 lb. weigh larry.

Cylindrical Steel Tank Storage with feeder and conveyor.

Suspended Steel Bunker Storage showing bunker and weigh larry.

When coal handling costs are too high for comfort, remember Gifford-Wood's 4-basic design story. Each of these storage designs—concrete silo, tile silo, cylindrical steel tank and suspended steel bunker—are carefully engineered to meet specific limitations of climate, capacity, space available and cost. The combination of extensive engineering experience and well known manufacturing ability assures installations of highest possible operating efficiency at reasonable cost.

A Gifford-Wood engineer, thoroughly familiar with coal handling problems, is at your service. Let him study your needs and recommend a G-W system that will both simplify the operation and reduce your costs.

4 BASIC G-W WAYS TO CUT COAL HANDLING COSTS

1. Reinforced Concrete Silo Storage
2. Vitrified Tile Silo Storage
3. Cylindrical Steel Tank Storage
4. Suspended Steel Bunker Storage

Bulletin No. 300 describes, with illustration and working drawing, these 4 basic G-W types of handling systems. Write today for your copy.

GIFFORD-WOOD CO.

SINCE 1814
Hudson, N. Y.

NEW YORK 17
420 LEXINGTON AVENUE

CHICAGO 6
565 W. WASHINGTON STREET

ST. LOUIS 1
RAILWAY EXCHANGE BUILDING

6378

G-W HANDLES IT . . . faster • easier • cheaper

Like this record of low-cost maintenance?

make it yours
with dependable quality

CRANE VALVES

No. 960 Crane Brass Pressure Regulator for steam or air. Literature on request through your Crane Branch or Crane Wholesaler.

A CASE HISTORY FROM CRANE FILES

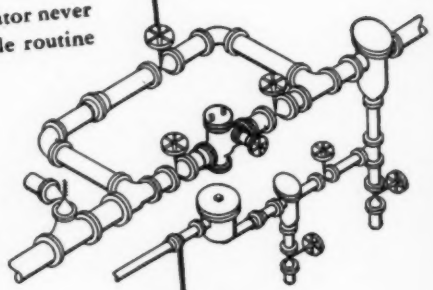
PROBLEM: To choose a pressure regulator that would assure a steady, unvarying steam supply to cooking kettle for an exacting brewing process.

WORKING CONDITIONS: Regulator subject to continuous operation 24 hours per day. Main steam supply at 100 psi to be constantly reduced and maintained at 30 psi.

SOLUTION: Crane No. 960 Brass Pressure Regulator. (*Former model with integral non-renewable cylinder.*)

RESULT: For 16 years, throughout its lifetime, the Crane 960 Regulator never failed, never faltered, never required more than prescribed simple routine servicing.

Replaced with new Model 960 Crane Pressure Regulator. With all wearing parts renewable, it will virtually never wear out. Now in service 18 months; operating cost: zero.



A typical example of the long life and low-cost maintenance that make Crane Quality the best value in all types of valves. That's why...
More CRANE VALVES are used than any other make

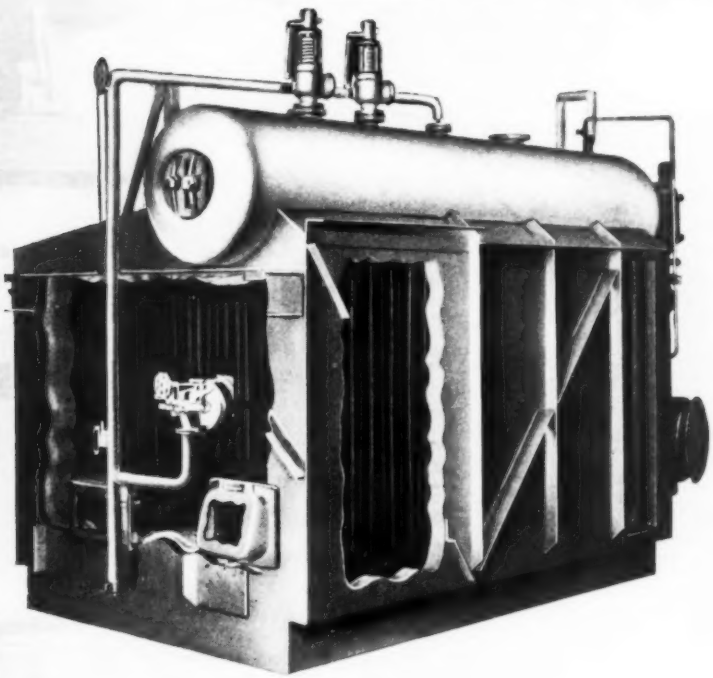
CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

"Package" with a "Pedigree"

Foster Wheeler—first in the design and fabrication of Water-tube Package Steam Generators



Units up to 30,000 lb per hr for both small and medium size plants

Foster Wheeler was building portable Water-tube Package Steam Generators as far back as 1940. Today, mounting orders from leading industries throughout the country testify to the fact that Foster Wheeler Package Steam Generators are "doing the job." These versatile units, which assure higher efficiency and real economy in the cost of steam production, reflect the broad background of Foster Wheeler industrial and central station experience. They are easily installed by means of a few service connections and are adaptable to various fuel and firing arrangements.

Let us show you how to modernize your plant the Foster Wheeler way at relatively low cost. *For further information, write...*

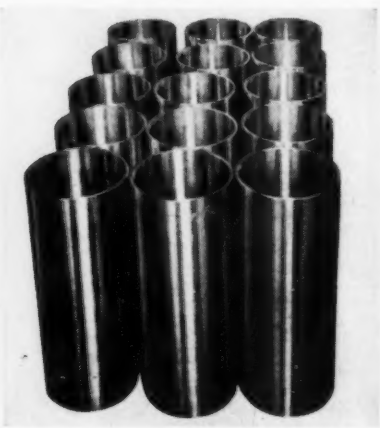
FOSTER WHEELER CORPORATION **165 BROADWAY, NEW YORK 6, N. Y.**

FOSTER WHEELER

for strong, hard, heat- and corrosion-resisting Castings

—consider MONEL, NICKEL and INCONEL

SAND CASTINGS



CENTRIFUGAL CASTINGS

PRECISION CASTINGS

If you want castings that must show long life—even under severe corrosive, thermal and mechanical conditions—investigate problem-solving Monel, Nickel and Inconel.

These Inco Nickel Alloys resist corrosion by most acids, alkalies and salts; they have the hardness needed to withstand abrasive and erosive attack; they are strong at high temperatures, at low temperatures.

"S" Monel's high hardness and resistance to galling make it a favorite material for all wearing surfaces where erosion is a factor. "H" Monel is used where better ductility is required on mildly abrasive applications.

Inco will supply the castings to your order from our own foundry at Bayonne, N. J. This foundry is maintained as a service to users of Nickel alloys.

Here, your order gets *double* expert attention. Attention by expert foundrymen; attention by foundrymen who are experts in casting high-Nickel alloys.

No matter what type of casting you need—sand, centrifugal or precision—the Inco foundry is equipped to fill your order.

What casting problem comes to your mind? Pass the details along to Inco at the address below. Let us work it out with you to see how economically it can be solved by use of high-Nickel alloys.

PRECISION CASTINGS ARE PRODUCED IN THESE METALS

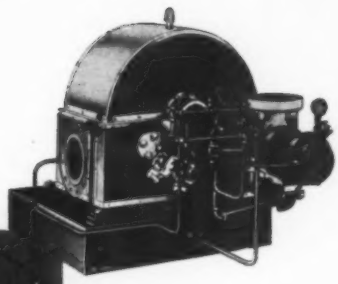
Monel®
"H"® Monel
"S"® Monel
Nickel
Inconel®
Ni-Hard®
Ni-Resist®
Stainless Steels
SAE, AISI, NE Steels
Tool Steels
Copper-Base Alloys
Cobalt-Base Alloys

EMBLEM OF SERVICE
INCO
TRADE MARK

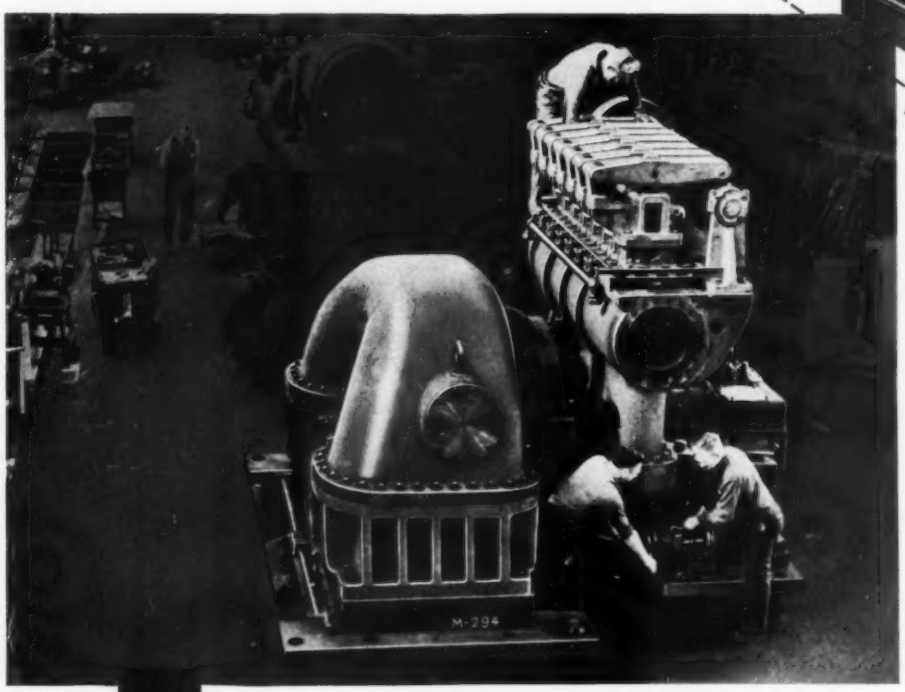
THE INTERNATIONAL NICKEL COMPANY, Inc., 67 Wall Street, New York 5, N. Y.

Think of Inco for Castings in durable metals

Compact, sturdy, dependable. A Worthington single-stage, centrifugal compressor-drive turbine.



FROM SMALLEST SINGLE-STAGE TO MULTI-STAGE GIANTS



A standout for size. One of two Worthington 24,000 hp centrifugal compressor-drive turbines during assembly.

Worthington Turbines Meet the Broadest Range of Drive Requirements

Worthington Turbines offer you unlimited choice of sizes and types — including straight condensing, straight non-condensing, extraction, mixed pressure extraction, low pressure and high back pressure. Steam or gas driven, for mechanical or generator drive, all are available with governors for constant or variable speed, with optional governor-control.

LOWER-COST BLOWER AND COMPRESSOR OPERATION

In the complete Worthington line you'll find the *right* speeds and horsepowers to keep your blowers, compressors and other mechanical drives operating at peak efficiency. And since each Worthington Turbine — from the smallest to the largest — is designed to make steam do more work, you can count on steady power- and money-saving throughout a long, trouble-free service life.

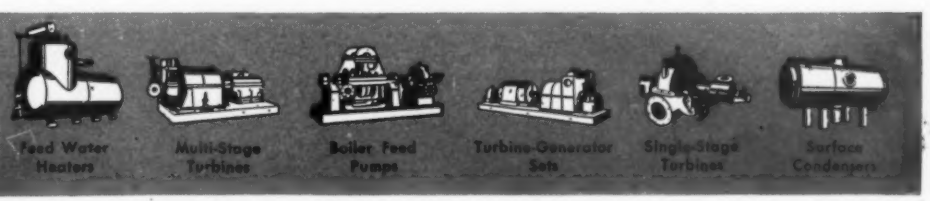
Get the whole story of this economical, always dependable power from your nearest Worthington representative. Or for further facts proving *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

T9-3

A GREAT TEAM IN STEAM



Who Buys VU-10 Boilers?

A quick answer is that VU-10 purchasers include industrials ranging from very small to the largest, as well as schools, hospitals, institutions, and, in fact, every type of establishment that requires boilers in the VU-10 capacity range. Why, then, limit the list of representative users on the opposite page to names known to everyone as among the biggest industrial enterprises in the country? Because such names form a significant guide for a prospective boiler buyer, in the same sense that the buying decisions made by operators of large truck fleets can be a reliable guide for the man who wants to buy a single truck.

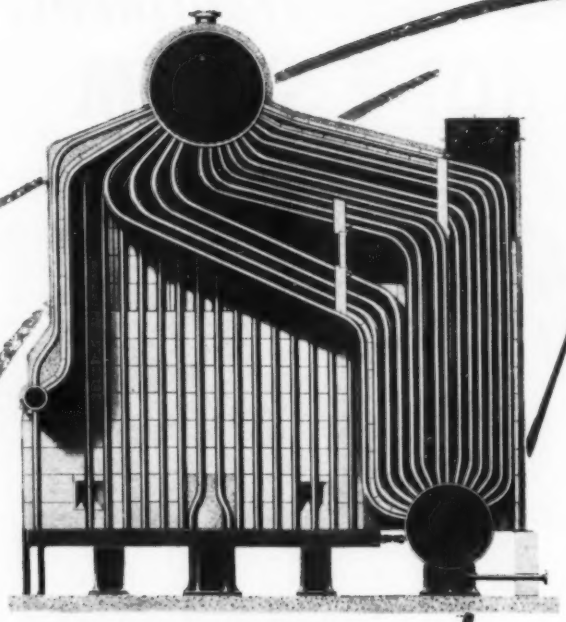
This reasoning applies *especially* to the purchase of a boiler. Big companies buy boilers frequently . . . therefore their experience is always up to date. They buy them for plants in many locations, using many different fuels. They buy them in capacities from very small to very large. Their requirements justify the employment of highly qualified engineering specialists—both staff men and outside consultants. Thus they have the breadth of experience and the expert guidance requisite to making the soundest equipment selections.

And perhaps equally important, big companies tend to place more emphasis on long-term operating and economic results. They know from their own experience that daily operating economies accruing through the years from better design and construction features will quickly offset the difference in first cost between the cheapest boiler they can buy and the best the market affords.

So if your steam requirements call for boilers in the capacity range from 10,000 to 60,000 lb of steam per hr, we submit the acompanying representative list of large companies that have purchased VU-10 Boilers as a sound reason for confidence that your decision to buy a VU-10 will prove to be a highly profitable one—not only for the first few years of service but throughout the lifetime of the installation. B-423

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



C-E Vertical-Unit Boiler

Type VU-10

The VU-10 Boiler is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 60,000 lb per hr. Firing may be by spreader, underfeed, chain or traveling grate stokers, or by oil or gas burners. Superheater, economizer or air heater surface may be added if desired.

Representative large companies that have purchased VU-10 BOILERS

Air Reduction Company
American Locomotive Co.
Armour & Company
Borg Warner Corporation
Thomas A. Edison, Inc.
Ford Motor Company
Robert Gair Company
General Foods Corporation
B. F. Goodrich Chemical Co.
Illinois Packing Company
Johns-Manville Products Corp.
Jones & Laughlin Steel Co.
Liebmann Breweries, Inc.
Liquid Carbonic Company
National Distillers Chemical Co.
New York Central R.R.
Owens-Illinois Glass Co.
The Pennsylvania Railroad
Remington Arms Company
Revere Copper & Brass Co.
R. J. Reynolds Tobacco Co.
Joseph Schlitz Brewing Co.
Sharpe & Dohme, Inc.
Sunshine Biscuits, Inc.

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

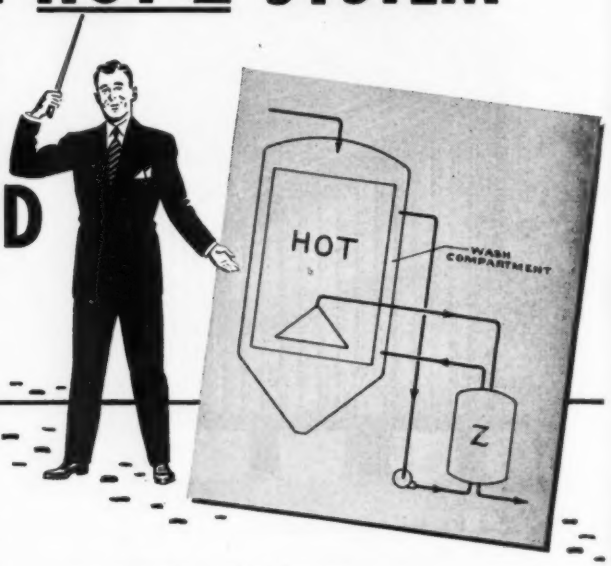
REVOLUTIONARY

advance in boiler feed water treatment!

WORTHINGTON HOT-Z SYSTEM

combines all the best features of

HOT PROCESS AND ZEOLITE



Choosing between Hot Process and Zeolite is no longer a boiler feed water problem. The Worthington Hot-Z System gives you the advantages of each system including deaeration.

SEE WHAT HOT-Z DOES FOR YOU:

1. Reduces hardness to 0.2 ppm without addition of excess soda alkalinity.
2. Operates on cheapest chemicals — lime and salt.
3. Saves enough in chemical costs to pay for average installation in 3 years.
4. Offers easy control when operating on variable waters.
5. Removes oxygen to 0.005 cc per litre.
6. Makes cumbersome two-tank lime-soda-phosphate systems obsolete.
7. Includes ideal facilities for the necessary hot clear water zeolite washing process.
8. Makes filters unnecessary except in special cases.
9. Does away with vent condenser scale.
10. Reduces phosphate precipitates in boiler to unobjectionable amount.
11. Reduces silica.

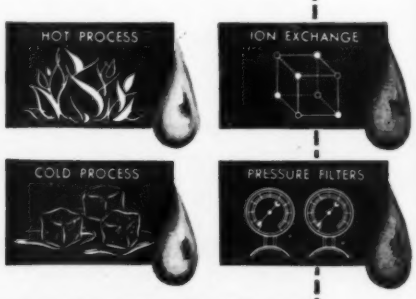
INVESTIGATE! If you are now considering split treatment, hold up your decision until you examine the Worthington Hot-Z System. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find in our Hot-Z System, as in so much other equipment, *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Dunellen, N. J.*

J0-2

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



Flanged bonnet, welding end, high pressure, gate valve.

WHEN YOU WANT

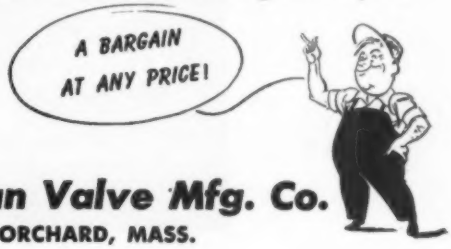
BOTH Precision and Economy

Specify CHAPMAN STEEL VALVES

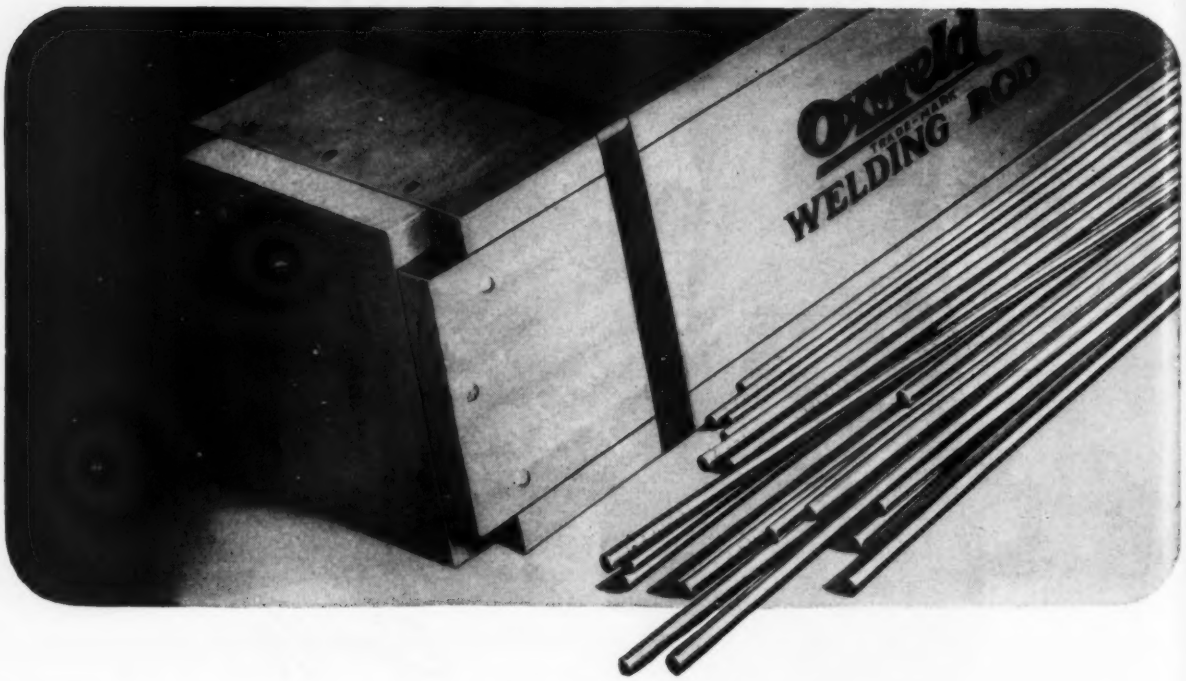
Want valves with precision ratings that equal or exceed standard specifications? Then specify Chapman Valves. You'll find them the equal of custom-made valves *every time.* Yet they are economical — with the economy that comes from production line manufacture.

You'll find it will pay to specify Chapman valves for every power plant need . . . for longer service, for better service, for lower maintenance.

Available in three types of body and bonnet connections — welded, pressure sealed or flanged. Also in gate, globe, angle, or check types. Welding end valves available in globe as well as in tilting disc styles.



The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASS.



How "OXWELD" Rods Reduce Welding Costs

Trade-Mark

☑ **You use less rod per weld,** because OXWELD Rods produce high-strength welds with minimum reinforcement. OXWELD No. 1 H. T. Rod, for example, has a tensile strength 11,000 lb. per sq. in. higher than any ordinary steel rod—enough *extra strength* to permit reduction of the amount of weld metal on a job, with substantial saving of gases and labor.

☑ **You weld easier and faster**—saving both time and gases—because all formulas for OXWELD Rods are worked out to give highest weldability as well as best possible physical properties in finished welds.

☑ **You get better welds at lower finishing costs,** because welds made with OXWELD Rods are always of uniform high quality, strength, and ductility—easy to machine and finish without excessive labor.

☑ **You need fewer types of rods** to handle your complete range of welding. Five OXWELD Rods—No. 1 H. T. Steel, No. 7 Drawn Iron, No. 25M Bronze, No. 23 Aluminum, and No. 9 Cast Iron—are sufficient for all average fusion welding, braze-welding, and bronze-surfacing. For the less frequent jobs of specialized nature, there are 9 additional welding rods and 8 hard-facing rods—all available from the same source.

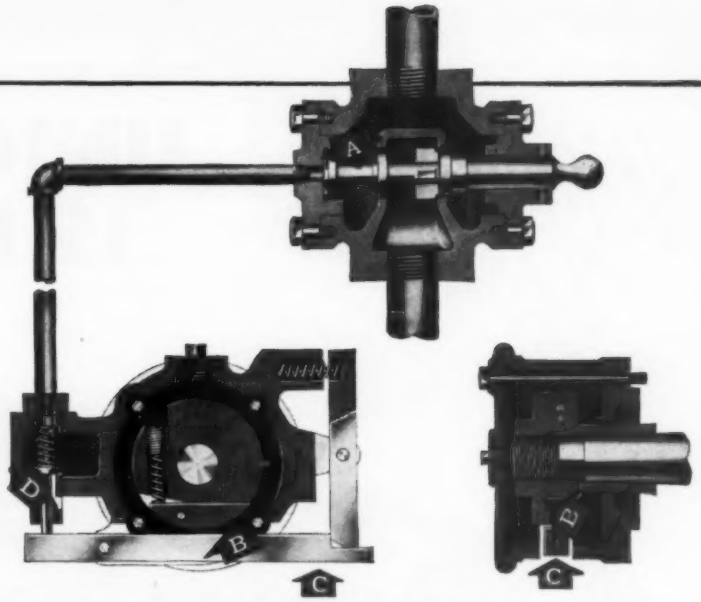
The term "Oxweld" is a registered trade-mark of Union Carbide and Carbon Corporation.

Look for the
Oxweld
Trade-Mark
on the rod or
on the box

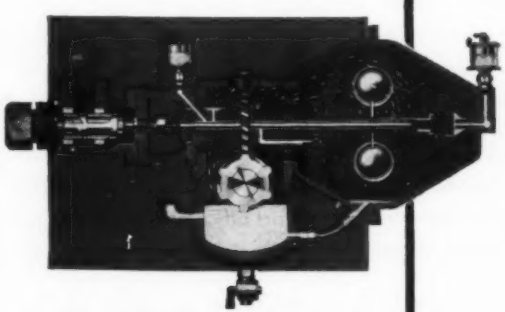
Order from your local Jobber

There's a PREST-O-WELD or PUROX Jobber nearby to serve you promptly. If you don't know him now, write us. The Linde Air Products Company, 30 East 42nd Street, New York 17, N. Y.

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 191 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Wherever You are...

UNION CHAIN IS NEAR BY

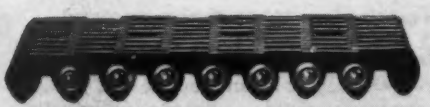
Suppose you need UNION Machine Finished Steel Roller Chain...

... and are certain of the pitch, length and sprockets required. Just write or phone your nearest Union Chain Stock Carrying Distributor as listed on the facing page. More likely than not, your requirements will be shipped immediately.

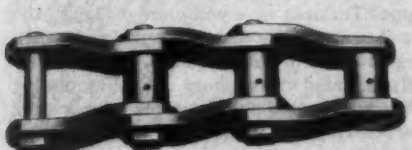
...or suppose you need engineering assistance in the selection of a drive or a recommendation for a conveyor application. Talk or write to Union Chain's nearest district office as listed at the top of the facing page. You will receive unprejudiced, competent help.

Unprejudiced because Union Chain makes all types of steel sprocket chains and is interested in providing each customer with the correct chain for satisfactory service at minimum cost.

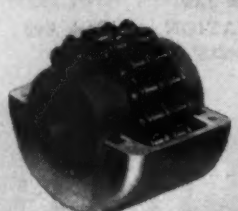
Competent because Union Chain representatives are qualified through experience to make sound chain recommendations whether the application calls for roller chain, silent chain or one of the various heavy drive or conveying chains. We suggest it might profit you to discuss your chain problems with us.



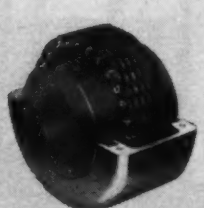
UNION SILENT CHAIN



UNION HEAVY DRIVE AND CONVEYING CHAINS



UNION ROLLER CHAIN FLEXIBLE COUPLINGS



UNION SILENT CHAIN FLEXIBLE COUPLINGS

UNION CHAIN REPRESENTATIVES

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American Chain & Gear Co.
C. A. Nicholas
5511 Pacific Blvd.
Huntington Park, Calif.

Hauhain Industrial Chain Co.
239-241 Twelfth St.
Oakland 7, Calif.

GEORGIA
H. F. Edge
208 Walton Bldg.
Atlanta, Georgia

ILLINOIS
Union Chain & Mfg. Co.
W. Albrecht
A. C. Mohr
B. Nelson
Room 1232
53 W. Jackson Blvd.
Chicago, Illinois

INDIANA
Paul W. Huddlestun
5745 Guilford Ave.
Indianapolis 20, Indiana

LOUISIANA
F. N. Johnston, Inc.
2207 American Bank Bldg.
New Orleans, La.

MASSACHUSETTS
Transmission Engineering Co.
Stanley Johnson
6 Hartford St.
Newton Highlands 61, Mass.

MICHIGAN
Union Chain & Mfg. Co.
W. J. White
Basso Bldg.
7338 Woodward Ave.
Detroit 2, Michigan

MINNESOTA
F. H. Bathke
490 N. Snelling Ave.
St. Paul, Minn.

MISSOURI
J. B. Flaherty
5473 Delmar Blvd. Rm. 206
St. Louis, Missouri

Ed Schiefelbein
1425 Troost Ave.
Kansas City 6, Mo.

NEW YORK
John B. Foley, Jr.
107 Tully St.
Syracuse, New York.

Mays & Gleason, Inc.
50 Church St.
New York 7, New York

Potter & Dugan
29 Wilkeson St.
Buffalo, New York

NORTH CAROLINA
M. R. Snyder Co.
304 E. Tremont Ave.
P. O. Box 3341
Charlotte 3, N. Carolina

OHIO
Union Chain & Mfg. Co.
F. H. Dalrymple
F. Smiley
Marshall Bldg.
Cleveland, Ohio

J. T. Young
Station A—Box 44
4860 W. Fork Rd.
Cincinnati 23, Ohio

OREGON
J. W. Minder Chain & Gear Co.
307 S. E. Hawthorne Blvd.
Portland 14, Oregon

PENNSYLVANIA
F. R. Magill
44 McKnight St.
Pittsburgh 20, Pa.

David Davies
P.O. Box 4
Plymouth, Pa.

Union Chain & Mfg. Co.
John A. Shoemaker
Room 521
Schoff Bldg.
Philadelphia 2, Pa.

TEXAS
Union Chain & Mfg. Co.
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E. T. Teal
918 Magnolia Bldg.
Dallas, Texas

WEST VIRGINIA
J. H. Ridge
P.O. Box 12
Bluefield, W. Va.

WISCONSIN
Union Chain & Mfg. Co.
George H. Harris
Room 508
Wisconsin Tower Bldg.
606 Wisconsin Ave.
Milwaukee 3, Wisconsin

SPECIAL Representatives

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New York 5, New York

E. F. Gahan
500 Fifth Ave.
New York, New York

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Munecas 110
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Rua Xavier de Toledo
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Caixa Postal 6064
Sao Paulo, Brazil

CUBA
Central Machine & Trading Co., S.A.
Lamparilla 208
Havana, Cuba

HAWAII
P. S. Pell & Co.
88 S. Queen Street
Honolulu, T. Hawaii

MEXICO
Thomas M. Nevin Y. Cia. S.A.
Manuel Maria Contreras 58
Mexico, D. F., Mexico

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The Edward J. Nell Co.
1450 Arlegui St.
Manila, Philippines

PUERTO RICO
Manuel Paiss, Jr.
P. O. Box 2969
San Juan 13, Puerto Rico

SOUTH AFRICA
Robins Conveyors (South Africa) Ltd.
Samkay House
Cor. Troye & Marshall Sts.
P. O. Box 4736
Johannesburg, S. Africa

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ALABAMA
Alabama Bearing Co., Inc.
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Montgomery, Alabama

Owen-Richards Co., Inc.
1009 Second Ave., North
Birmingham, Alabama

ARKANSAS
North Arkansas Equipment Co.
930 N. College Ave.
Fayetteville, Arkansas

CALIFORNIA
American Chain & Gear Co.
5511 Pacific Blvd.
Huntington Park, Calif.

Hauhain-Industrial Chain Co.
239 Twelfth St.
Oakland, Calif.

Valley Belting & Equipment Co.
2909 Los Angeles St.
Fresno, Calif.

CONNECTICUT
Motor Equipment Co.
Wall & Water Sts.
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L. W. Rapkin Co.
Third St. & Shipley
Wilmington 40, Delaware

FLORIDA
Ellis & Lowe Co., Inc.,
302-306 S. Morgan St.
Tampa, Florida

Farquhar Machy. Co.
720 West Bay St.
Jacksonville, Florida

General Equipment & Supply Co.
704 N. E. First St.
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GEORGIA
Georgia Hardware & Supply Co.
307 N. Washington St.
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Macon Supply Co.
Macon, Georgia

Richmond Supply Co.
Augusta, Georgia

John D. Robinson Co.
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Savannah, Georgia

GEORGIA
Travis Belting & Supply Co.
P.O. Box 289
Griffin, Georgia

J. M. Tull Metal & Supply Co.
285 Marietta St., N.W.
Atlanta 3, Georgia

ILLINOIS
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Chicago 16, Illinois

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W. M. Hales Co.
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616-24 N.W. Second St.
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Bearing Service Co.
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W. A. Thomas Supply Co.
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Weeks Supply Co., Ltd.
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MARYLAND
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M. F. Holland Co.
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Kansas City 10, Missouri

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Power Drives, Inc.
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Transmatic Equipment Co.
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U. & S. Inc.
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Ulster Foundry Corp.
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Lima, Ohio

Mill & Factory Supply Co.
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Lloyd Electric Co.
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Bassett, Virginia

Mill Supplies Corp.
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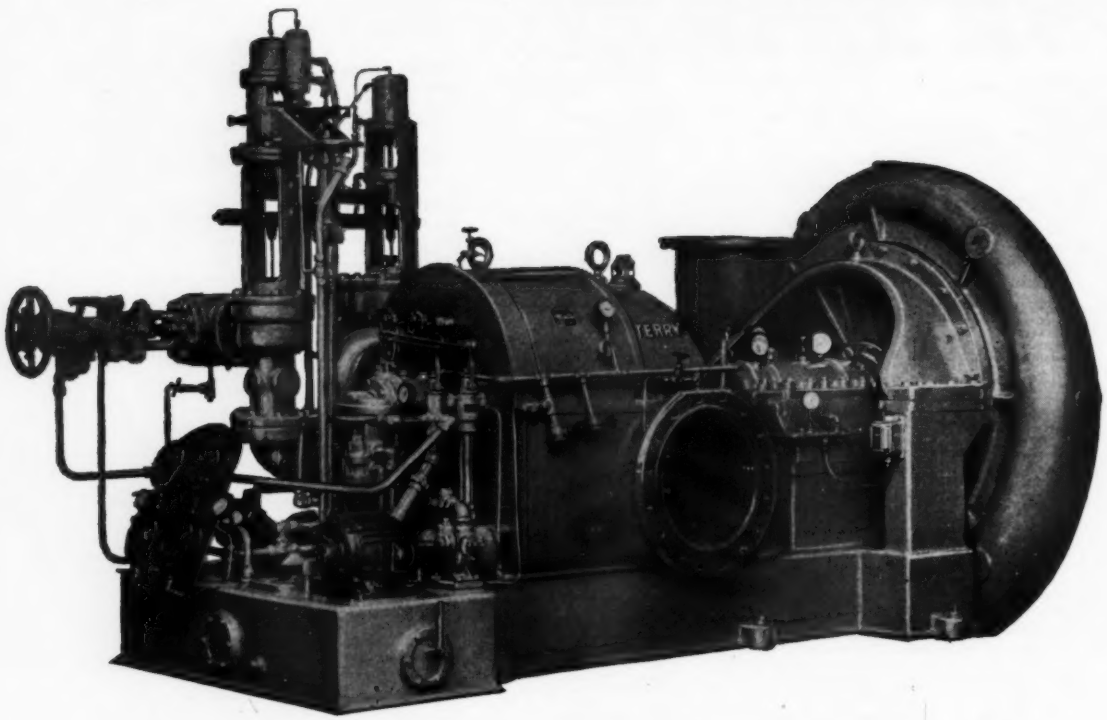
The Union Chain and Manufacturing Company — **Sandusky, Ohio, U.S.A.**

TRANSMIT POWER
UNION CHAINS
CONVEY MATERIALS

The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

HERE'S *Insulation* AT ITS BEST!

In the illustration above, Mica-Glas is being visually inspected and gauged for correct thickness. Bond content, dielectric strength, slippage and other characteristics are very carefully checked during manufacture and as a final inspection before shipment.

Mica-Glas, which is built up of hand-laid premium mica with glass cloth backing, has high dielectric strength, is resistant to heat and impervious to moisture.

With either long-life synthetic resin or silicone bonding, it is available in sheets, rolls and tape, in standard thicknesses and widths. In addition, Mica-Glas can be obtained in .0035" thickness—ideal where a minimum of space is available, and for turns of small radius.

To insure uniform insulation value, National impregnates the glass cloth in a National-designed coating tower which meters and cures the varnish with uniform accuracy. Mica splittings are applied under close control and are bonded tenaciously to the glass cloth. When you use Mica-Glas you *know* your electric windings are using the best.

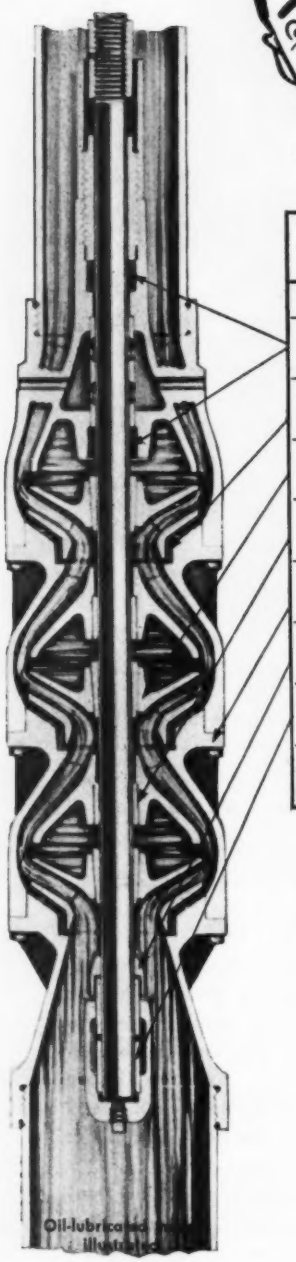
NATIONAL MICA-GLAS INSULATION
TRADE MARK

Use Mica-Glas, and other National insulation, for *known high value*. Some of the world's largest manufacturers of electrical equipment standardize on it.

Before you buy a vertical turbine pump

CHECK WORTHINGTON AGAINST THE FIELD!

Chart shows only Worthington gives you all 8 vital design-features as standard equipment



The Ten Leading Makes Of Vertical Turbine Pumps
√ Indicates Feature Is Standard

Standard Features	Worthington Type Q	Pump A	Pump B	Pump C	Pump D	Pump E	Pump F	Pump G	Pump H	Pump I
Seals above and below drain parts (oil-lubricated model)	√									
Wearing rings	√				√			√		
Enclosed impellers	√	√	√	√	√	√		√	√	√
Bronze bushings in bowl assembly	√		√	√	√	√		√	√	√
Flanged and bolted bowls on all sizes	√						√		√	√
Sand collars at both ends of bowl assembly (water-lubricated model)	√	√								
Grease-packed bottom bearing	√	√			√					√
Choice of oil or water lubrication	√	√	√	√	√	√		√		

There's your quick, complete picture of how Worthington Type Q stocks up against competition. Remember — each of the features listed is a proved aid to more efficient pump performance. And only Worthington gives you all of them as standard!

Why settle for anything less than this all-inclusive, ahead-of-the-parade design that assures smoother, lower-cost pumping?

Maximum Head In All Sizes

Available in sizes from 6″ to 32″, Worthington Type Q Vertical Turbine Pumps handle liquids at temperatures of 7° below zero F to 500°F, with maximum head per stage over the entire size range.

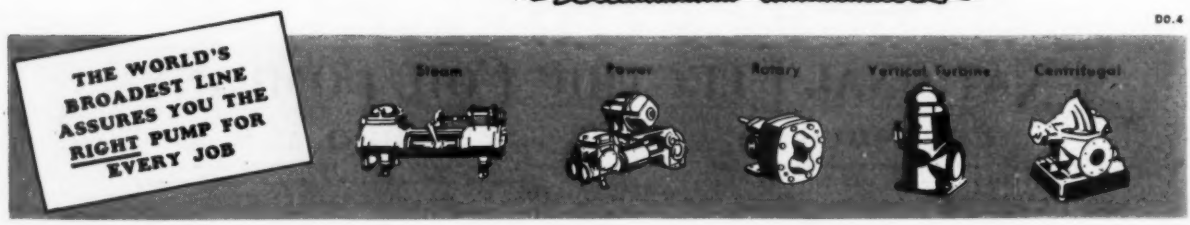
See your local Worthington dealer for the whole story that proves *there's more worth in Worthington*. Complete manufacturing and servicing facilities at Denver, Colo., and Harrison, N. J. *Worthington Pump and Machinery Corporation, Harrison, N. J., Denver 16, Colorado.*

Dealer Franchises Open

WORTHINGTON

DO.4

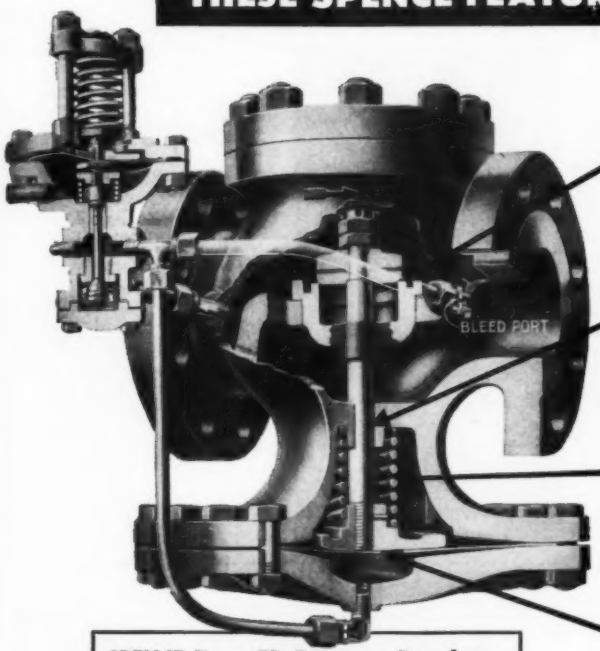
THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB



HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

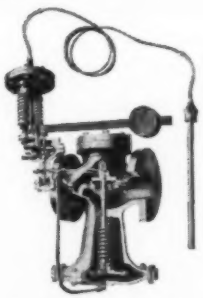
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

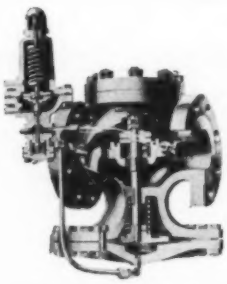
LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

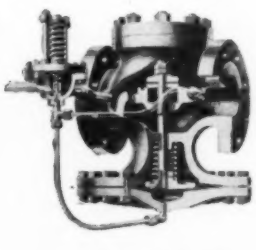
Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.



Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

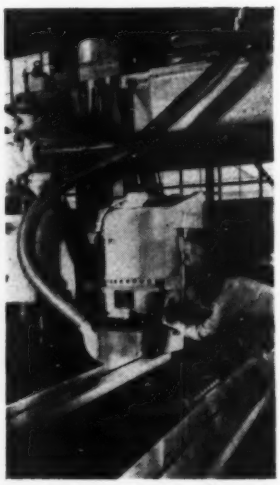
SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

Answers to tough piping, hose and conduit problems can be simple

Hazardous? And how!

Open wiring in grain elevators is forbidden by code requirements. But rigid conduit from switch to motor in this installation would prevent necessary adjustment of the motor drive. SEALTITE* (American Flexible Metal Hose with an impermeable synthetic covering) offered the ideal solution—combining complete safety with flexibility. Photo courtesy Produce Terminal Corporation, Union Stock Yards, Chicago, Ill.



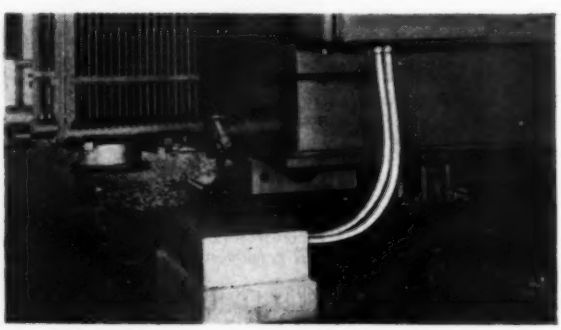
Gulps Grit

The American Flexible Metal Hose shown on this big grinder has plenty of grit—gulps it regularly. It can take it, too, because it's plenty tough as well as flexible. That's a combination of special value in many a job for which this versatile hose should be considered. Photo courtesy Simmons Machine Tool Corporation, Albany, New York.

Ideal for Innumerable uses

American Flexible Metal Hose and Tubing are made in an extensive variety of styles and metals for conveying liquids, many chemicals, air, steam, vapors, oils, greases, gases and semisolids, under severe conditions of corrosion, temperature, pressure and mechanical stress; for protecting wiring and flexible drive shafts; and for connecting piping or ports that vibrate, move, or are out of alignment. For information on any type of American Flexible Metal Hose and Tubing—or for help in special problems—write to The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Co., Ltd.

*Trademark



A Neat "Settlement"

They wanted the feed wires to this transformer in conduit. But they expected a settling action might occur which would put a dangerous strain on rigid conduit. So they used SEALTITE*, combining flexibility with complete protection. A neat settlement of a common problem. Photo courtesy Pacific Gas & Electric Company, San Francisco, Calif.

Wherever connectors must move

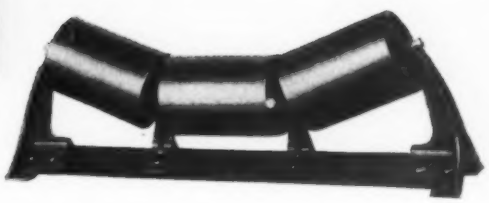
ANACONDA
from mine to consumer

American FLEXIBLE METAL HOSE AND TUBING

The Right Equipment · · · Engineering Experience · · · Background

Three most important requisites. Put them all together . . they spell RELIABILITY. Jeffrey has all three . . can put them to work for you . . can help you speed all sorts of material on its way. Single units or complete systems backed by sound engineering and over 70 years of experience. To do that material handling job exactly and economically . . call on Jeffrey.

- Apron Conveyors
- Belt Conveyors
- Bin Valves
- Bucket Elevators
- Car Pullers
- Coal Preparation Equipment
- Chains
- Coolers
- Crushers
- Dryers
- Feeders
- Idlers (belt)
- Jigs (coal washing)
- Magnetic Separators
- Pivoted Bucket Conveyors
- Pulverizers
- Scraper Conveyors
- Screens
- Spiral Conveyors
- Skip Hoists
- Sprockets
- Transmission Machinery
- V-Bucket Conveyors



Jeffrey carrying and return Idlers, equipped with Timken tapered roller bearings, are designed for belt conveyor service where efficiency, dependability and economy are desired. Available in four types.

Your inquiry will be given prompt attention. Costs lurk in unexpected places — likely our Jeffrey engineers have worked out a solution to a problem similar to yours. Write today.

THE JEFFREY MANUFACTURING COMPANY Established 1877

814 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

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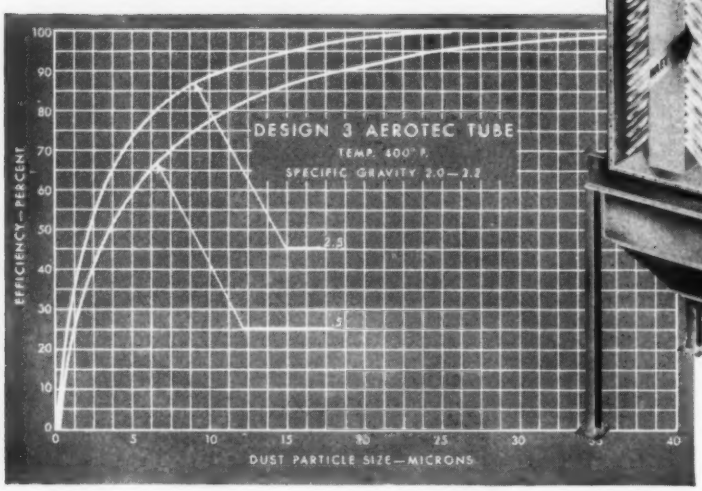
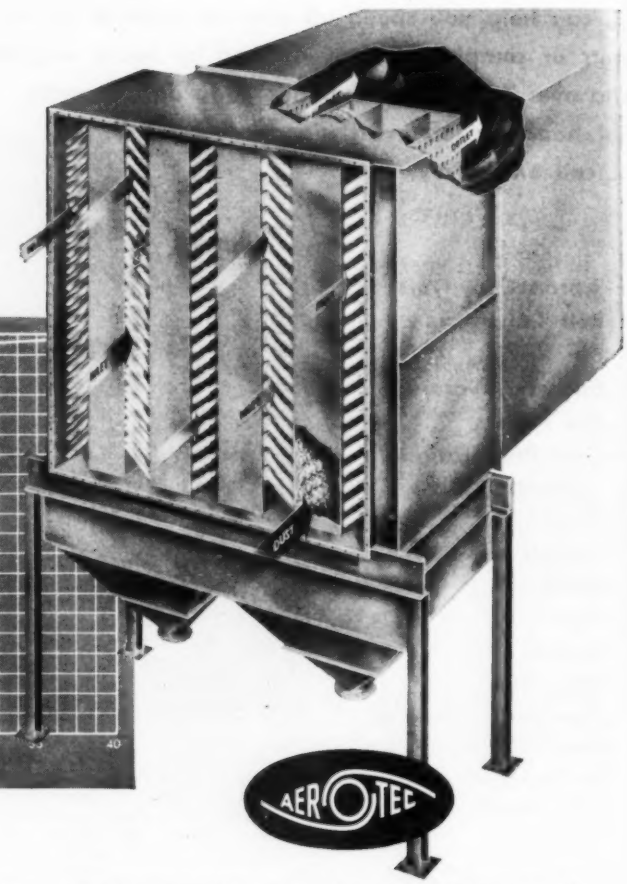
Baltimore 2 · Beckley, W. Va. · Birmingham 3 · Boston 16 · Buffalo 2 · Chicago 1 · Cincinnati 2 · Cleveland 15 · Denver 2 · Detroit 13 · Harlan, Ky. · Houston 2 · Jacksonville 2 · Milwaukee 2 · New York 7 · Philadelphia 3 · Pittsburgh 22 · St. Louis 1 · Salt Lake City 1 · Scranton 3

Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

ON *Full* OR *Partial* LOADS

AEROTEC DUST COLLECTOR EFFICIENCY *is still high*





Keeping efficiency high on a fluctuating boiler load is important in meeting dust ordinances. The Aerotec Design 3RAS Collector has solved this problem by the use of small diameter tubes.

It will be seen from the curve that 2.5 w.g., efficiency on 20 micron particles, at full load, is 98%. Reducing the load to 0.5 w.g., equivalent to half load, the Aerotec Collector still provides an efficiency of 91.5%, ample to meet most dust ordinance requirements encountered.

These small diameter tubes also provide a compact unit that will fit into almost any space requirement, a factor that is extremely important when the installation is made in an existing power plant where space is usually at a premium.

Project and Sales Engineers

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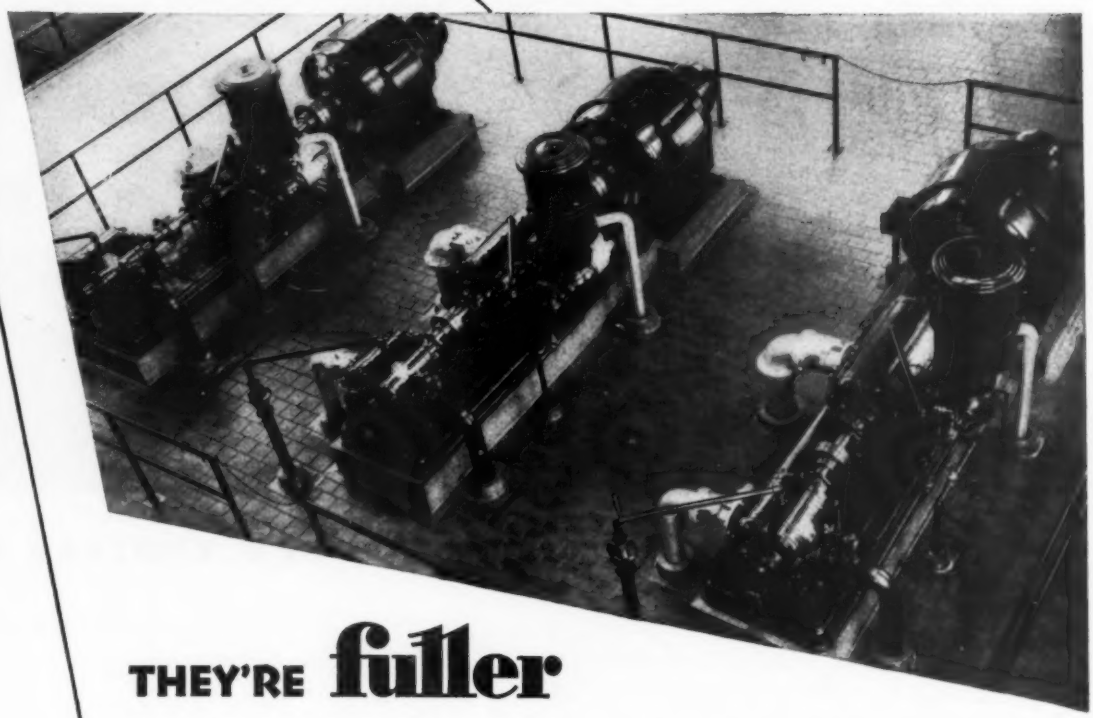
THEY'RE COMPACT . . .
CLEAN-CUT . . .
EFFICIENT . . .
PULSATION-FREE



THEY'RE fuller

One West Coast manufacturer never has to worry about air for pneumatic services in his plant. He's installed a battery of three Fuller Rotary Two-Stage Compressors. Each has a capacity of 1085 cfm, 100-lb. pressure. The installation is compact, is streamlined, clean-cut, efficient in operation. Vibration is kept at the minimum. And what's especially interesting is the fact that they require no heavy foundations. In this particular installation, they have been mounted on comparatively light terrazzo foundations *. . . and they're on an upper floor of the building.*

Fuller Rotary Compressors are designed and built to give a lifetime of new machine service. They're simple in design, are easily operated, ruggedly built. Thousands of Fuller Rotary Compressors are maintaining peak efficiency in plants of every size and description throughout the country. They've *earned* their reputation for complete dependability.

Bulletin C-5 gives you complete information on these quality compressors. You'll want to study it carefully . . . see how well Fuller fits into your own plans and operations.

fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—
COMPRESSORS AND VACUUM PUMPS—
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FULLER COMPANY, Catasauqua, Pa.
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C-196

Only ONE take-up in 3 years of 24-Hour Daily Service

...Typical Record of Condor WHIPCORD ENDLESS BELT

Pictured above is one of two Condor Whipcord Endless Belts, 16" x approx. 36', installed by National Paper Corp., Ransom, Pa. in December 1946. The belt is photographed in motion because that is generally the way you'd see these rugged belts . . . They both operate 24 hours every day in the week except Sunday. In three years of this constant service on Jordan Beaters, only one take-up has been made. Note that no idler is used. Both belts are good for more years of trouble-free service.

The remarkably low inelastic stretch in Condor Whipcord Endless Belts is due to Manhattan's method of de-stretching the cord strength-members during manufacture. Virtually all inelastic stretch is taken out of the belt. Also a Condor Whipcord Belt is not affected by atmospheric condition, because the stout Whipcords are impregnated with Flexlastics and protected in the body of the belt.

Another feature that contributes to the long life of Condor Whipcord Belts is the exclusive Extensible-Tip cover splice that prolongs belt life 3 to 10 times. "Elasticising" and rubber rivetting the cover ends prevents seam opening.

Condor Whipcord Belts offer you additional advantages of outstanding flexibility, with no ply separation and no splice in the load section. If you have drives that need constant take-up and heavy idler tension . . . if you are losing production because of belt trouble . . . try Condor Whipcord Endless Belts.

Write for Bulletin 6869-D

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

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INDUSTRIAL POWER

November, 1950 Vol. 59, No. 5

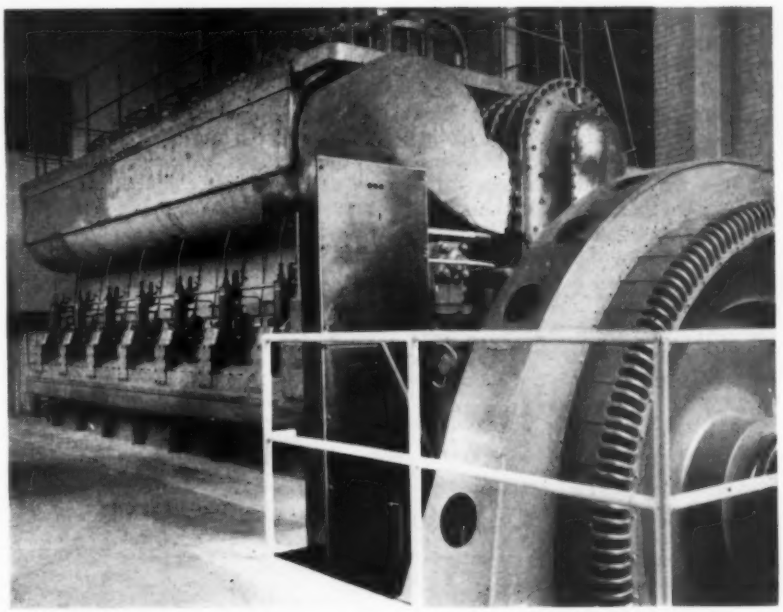
RENSSELAER'S POWER PLANT EXPANDED, DIESEL CAPACITY NOW TOTALS 7,150 HP

Starting in 1924 with the installation of the original diesel, this municipality has increased its capacity with individual units in 1928, 1932 and 1940. Latest diesel is rated 2,800 hp

TO KEEP up with the ever expanding power demand the city of Rensselaer, Indiana, has just installed another diesel engine. This time the unit has a rated horsepower of 2800 and brings the total capacity to 7150 hp. This engine has seven cylinders of 21½ in. bore and 29 in. stroke, of mechanical injection, trunk piston design and operates at 225 rpm. It drives a 2400/4160-v, 3 phase, 60 cycle, 1980-kw generator with 25-kw V-belt driven exciter. Since placed in service, this engine has carried the major portion of the load. Normally it is operated from 14 to 16 hr each day until the load drops to where it can be carried by one of the smaller units. In March, the engine operated 444 hr, generated 475,000 kw-hr on 36,440 gal of fuel oil or a production of 13 kw-hr per gal with the engine carrying an average load of 54 per cent. Lube oil consumption for this period was 10 gal in the crankcase and 126 gal for cylinder lubrication at the rate of 9141 hp-hr per gal. Comparing present day production with first diesel installed showed in two months this 2800 hp engine generated an amount about equal to the entire annual output in 1925.

Mounting costs have affected operations at Rensselaer in the same manner as other plants engaged in the generation of power. In 1940, 4,067,200 kw-hr were generated with a fuel cost of $18,914.50, while in 1949, the production had grown to 6,906,500 kw-hr, but the cost of fuel had risen to $74,470.29. Operating labor also had shown a similar increase. This has increased from $4130.54 in 1940 to $8016.30 in 1949.

Provision is made for an adequate supply of fuel in case of emergency. At the present time, fuel is delivered to the plant by truck, three times a week from the refinery. In addition fuel can also be received by rail. At a siding about six blocks from the plant is a 90,000 gal vertical tank with pump house and a small motor driven pump for unloading and transfer to truck.

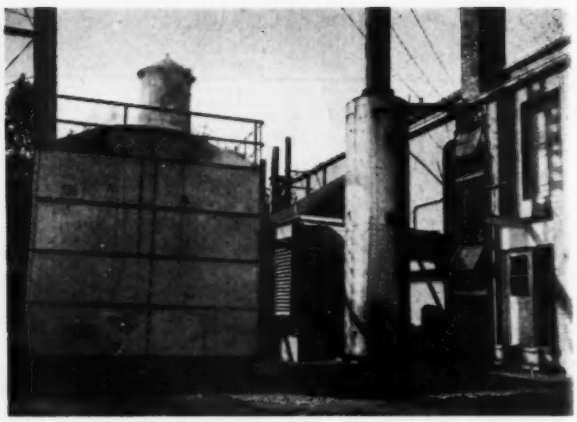


Mechanical injection diesel engine drives a 3 phase, 60 cycle, 2400/4160-v generator at 225 rpm. Normal operation is 14 to 16 hr per day during peak load period

At the plant are two 26,000 gal above ground horizontal storage tanks with motor driven pump for unloading. From these tanks, fuel is delivered to an elevated inside storage tank by a 1 hp motor driven pump. From this tank all fuel flows by gravity to the engine day tanks. Fuel flows by gravity to the fuel pump and is pumped to duplex filters and then to the fuel header, which feeds the injection pumps. There is also a 1½ hp pump located in the storage room for transferring fuel direct from outside storage to day tanks.

In the past considerable difficulty was encountered from the corrosive action of the water on the piping. To rectify this situation closed cooling water systems were installed for all engines, and soft water is circulated in the cooling and jacket water circuits.

Oil purifier, day tank and auxiliary fuel transfer pump are at engine room floor level to safeguard against high water



All metal cooling tower supplies water to the jacket and lube oil heat exchangers. Exhaust passes through muffler

For the four older engines, there are two atmospheric-type wood cooling towers, and a forced air tower of metal construction services the new engine.

Cooled soft water from the tower is circulated through a lube oil cooler and then through a heat exchanger with a 700 gpm, 70 ft head, 20 hp pump and then returned to the tower. Jacket water is circulated through a heat exchanger with a similar capacity pump. The jacket water circuit has an overhead surge tank. Provision has been made to supply raw city water to the jacket and oil cooling circuits.

There are two lubrication systems. Pistons have force-feed lubricators, one for each cylinder, and oil is delivered to six points around the upper periphery of the liners. Crankshaft journals, crankpins, piston pins, camshaft bearings, gears and piston cooling are serviced with a circulating pressure system. Oil from the bearings and pistons drains into a sump, and a built in pump circulates it through a duplex strainer, lube oil cooler and returns it to the engine. A purifier removes lube oil from the sump, purifies and returns it to the sump supply.

Auxiliary lube oil equipment consists of a 285 gpm pump driven by a 15 hp motor. This unit serves as standby and supplies lubrication for starting the engine and after shutdown. A pressure switch starts the pump should the lube oil pressure drop below a predetermined level in the engine crankcase.

Air for scavenging is drawn through a continuous self cleaning curtain type air filter having a capacity of 12,900 cfm by a gear driven blower mounted at the flywheel end.

Electrically operated switchboard of five panels is located adjacent to the 2800-hp engine. This board has a tie-in panel to the main distribution. A 60 cell battery furnishes energy for operating this board.

Quiet operation is paramount and noise has been eliminated by installing exhaust and intake snubbers.

Mounted on the engine gage board is an alarm for low pressure and high temperature of jacket water and lube oil. Also on this board is a pyrometer for determining exhaust temperatures.

PRINCIPAL EQUIPMENT FOR RENSSELAER DIESEL POWER PLANT

Diesel Engine	Nordberg Mfg. Co	Cooling Water Pumps	Allis-Chalmers Mfg. Co
Generator	General Electric Co	Lube Oil Purifier	Honan-Crane Corp
Exciter	General Electric Co	Scavenging Air Filter	American Air Filter Co., Inc
Storage Fuel Oil Pump	Viking Pump Co	Switchboard	General Electric Co
Fuel Oil Filters	Wm. W. Nugent & Co., Inc	Battery	Electric Storage Battery Co
Stand by Fuel Oil Pump	Blackmer Pump Co	Snubbers	Burgess-Manning Co
Cooling Tower	The Marley Co., Inc	Alarm System	Viking Pump Co
Lube Oil Cooler	Ross Heater & Mfg. Co., Inc	Temperature Recorder	Illinois Testing Lab

Dye Exposes Microscopic Cracks

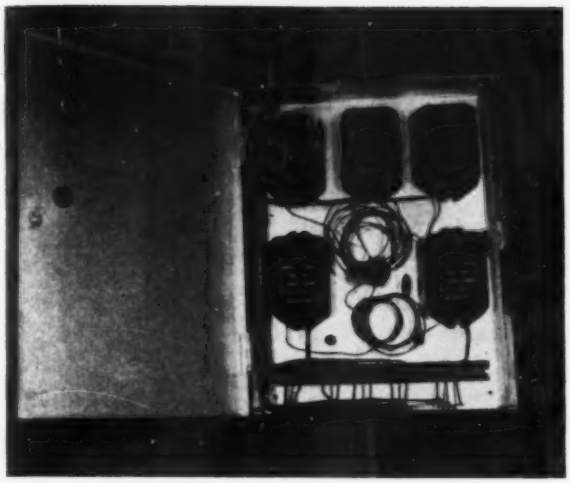
● Some liquids possess an extremely high capillary action and have the ability to penetrate and flow in very narrow spaces. Scientists at The Turbodyne Corp., a subsidiary of Northrop Aircraft, Inc., looked for and found a liquid, which has an intense red color. They also found a material which, when painted on a surface, leaves a white coating.

Briefly, the part suspected of having a crack is cleaned with a solvent and painted with the red liquid dye. It is allowed to stand for five minutes so cracks or surface openings can absorb the dye. Next, it is wiped and painted.

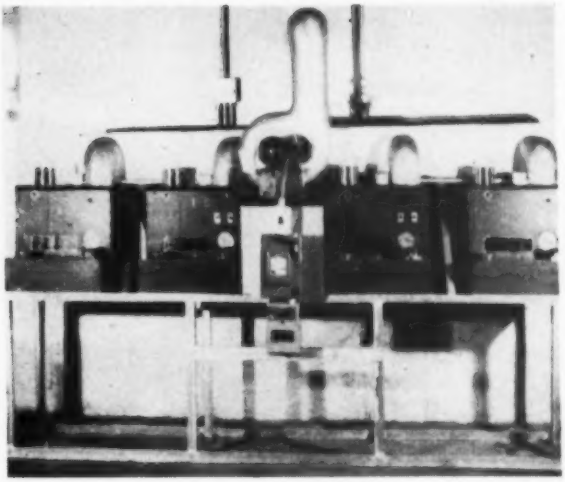
Any surface openings can be detected by the presence of fine red lines. While the process reveals only surface flaws it is also adaptable to the inspection of many parts not practical for existing methods.

One valuable application lies in inspection of welds. Ordinarily it is necessary to grind all irregularities and attain a smooth surface before a reliable indication of a fine crack can be found with magnetic or X-ray processes.

Any surface, either ferrous or non-ferrous, that is accessible for wiping and painting operations may be inspected. Frequently a part can be tested for cracks without dismantling the machine. Being a simple and inexpensive process it is practical to inspect critical components such as crankshafts, turbine blades and flywheels during overhaul.



Indoor-outdoor controller automatically adjusts inside conditions to one-third the difference between outside and 70F



Triethylene glycol apparatus purifies the air by removing odors. Fluid is sprayed into airstream at the heating coils

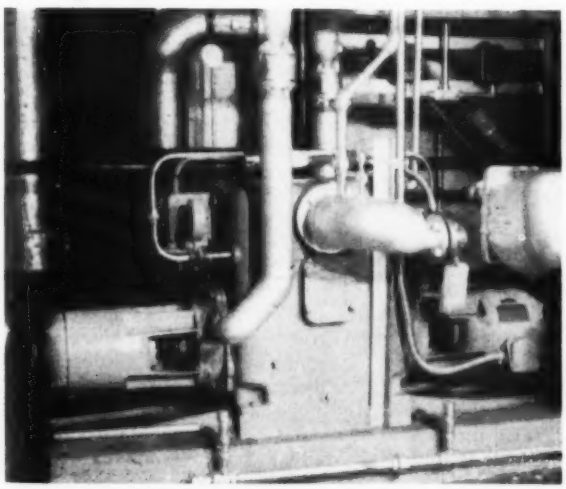
PURIFICATION FEATURES CONDITIONING SYSTEM

Of particular importance is the utilization of triethylene glycol — an excellent chemical deodorizer — to purify conditioned air. Outdoor compensating thermostat controls all inside temperature conditions during the heating and cooling seasons. Final temperature control is by means of individually located thermostats in each zone

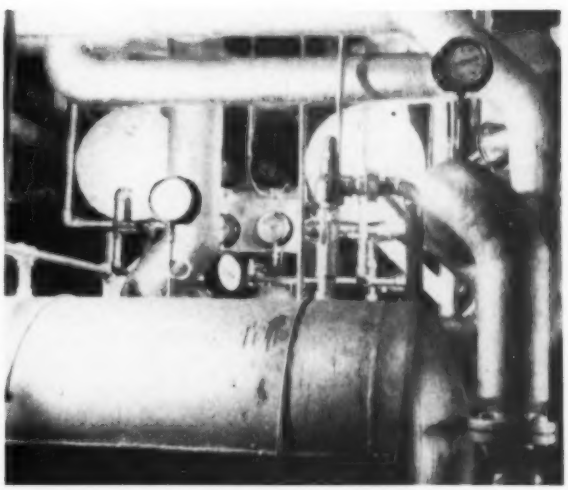
L. F. CLIFFORD, ***Consulting Engineer***

MANY new developments are incorporated in the new home of the Allstate Insurance Co., a subsidiary of Sears, Roebuck and Co. Among these are temperature and humidity regulation in relation to outside conditions; extensive and complex controls operated by low voltage electricity; air purification by the use of triethylene glycol and air filtration by electrostatic precipitation.

Application of the most recent advances in air conditioning techniques, including the development and incorporation of special equipment, has produced a system whose operation is completely automatic. A penthouse houses the mechanical equipment, which includes two main supply fans with heating and cooling coils and two main ex-

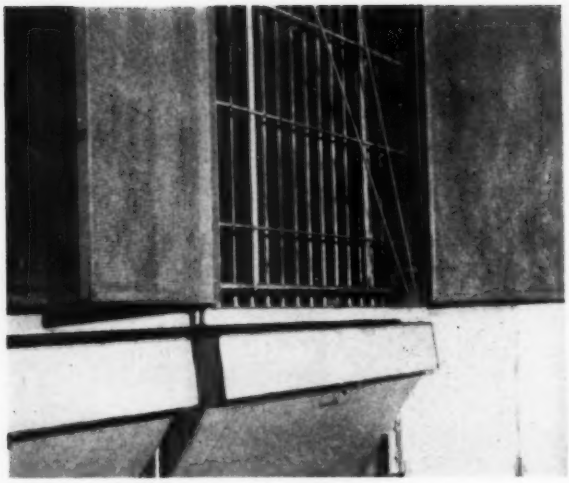


Pumps for individual convectors return condensate to the boiler make-up supply system located in the main building



Hot water is maintained automatically at 90 to 120 F, depending on outside conditions, with three steam convectors

Chilled water cooling coils installed at an angle provide greater surface area, which assures low coil face velocity



Two identical electrostatic air filters with oil reservoirs. Alternate operation provides for oil bath cleaning

haust fans. The air conditioning system is controlled from this location.

There are three control panels, one for each set of fans, and one main panel called the "engineer's panel." Located on each fan panel is the indicating and control equipment relative to its own fan system. On the engineer's panel are controls for the fresh air dampers for each fan as well as other controls and gages common to both systems.

Temperature Control

Air temperature is controlled automatically by thermostats in each zone, or manually from the engineer's panel. On automatic operation, the summer thermostats are differentially controlled by outside thermostatic adjusters. The resulting temperature equals one-third of the difference between the outside DB and, 70 F, plus 72 F.

For example assume an outside temperature of 95 F. The difference between 95 and 70 F is 25. One-third of 25 is approximately 8. Eight plus 72 F equals 80 F which is the controlled inside temperature.

Mounted on the fan panels is a complete array of dial thermometers and gages giving temperature readings for each zone throughout the building. Compensating capillary-type tubing connects the thermal bulb to the indicating dial. In addition, indicating gages and meters on all three panels show the actual mechanical position of the control devices associated with that part of the panel.

Air is brought into the building through four roof intakes. Two air supply fans, having a capacity of 140,000 cfm, have adjustable vortex control which permits close regulation of the air volume. In this design, a single lever operates the main gear in the center of the control, and the motion is transferred to individual blades through pinion gears. Fans are connected to the ducts with canvas.

Air passing through each fan system is proportioned by dampers controlled from the engineer's panel. Discharged air is through two roof exhaust outlets. All air, both make-up and return, passes through the filters. Basement air is exhausted to the outside along with air from washrooms and locker rooms on each floor.

An automatic type electrostatic filter provides initial air cleaning. Particles of dust and dirt are precipitated onto electrically charged metal plates and held there by a viscous coating. Secondary air filtering is done by banks of dry type filters.

Filtered air then passes through chilled water coils. Face and bypass dampers control the leaving temperature. Cooling coil temperature is controlled by an immersion microtherm located in the chilled water return line. The microtherm operates a modulating valve which maintains a constant discharge temperature of the chilled water from the cooling coils.

Air Distribution

Conditioned air is distributed to 10 zones—5 zones per each fan system. The basement and lobby areas constitute two zones, one allotted to each fan. The other four zones for each fan are vertical units throughout the height of the building.

Conditioned air is delivered through adjustable uniflow double-deflecting grilles. These grilles are constructed in two parts, increasing the ease of installation and maintenance. The frame can be installed separately and finished along with the wall surface.

General heating is accomplished with a dual type system. This consists of hot water convectors and heated air from the ventilating system.

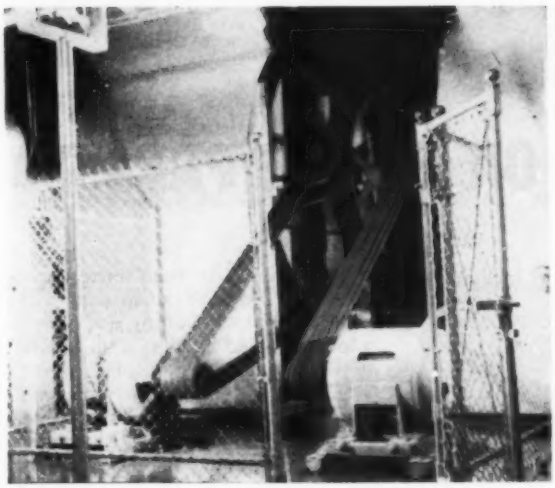
There are eight high-pressure steam coils arranged in two banks above the cooling coils. A thermal bulb on the discharge side of the coils is set to maintain a constant hot chamber or leaving air temperature of 155 F.

During mild weather, zones exposed to sunlight require cooling while those in the shade need heat. The basement has little heat loss, and this area requires cooling while the building above grade level is still being heated. Ducts to each zone have separate cooling and reheat coils equipped with dampers.

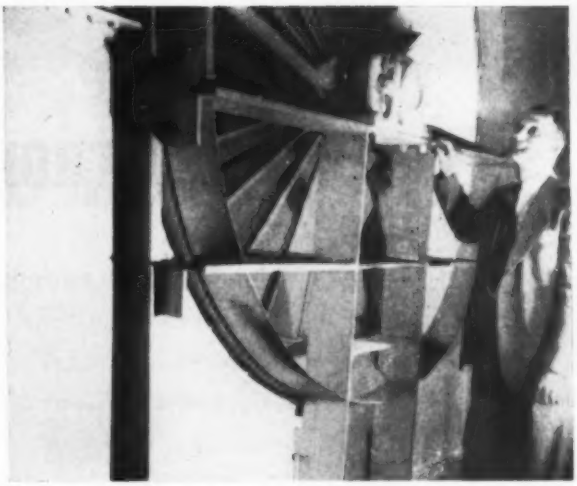
One of the unique features of this installation is purification of air after it leaves the heating coils by inserting triethylene glycol vapor into the air stream. Glycol has been shown to kill air borne bacteria, especially the common cold germ. This procedure is expected to minimize winter colds and illness among employes, thereby lessening absenteeism from work.

To hold proper humidities water vapor is evaporated into the air from pan type humidifiers that contain submerged high-pressure steam coils. Steam is metered automatically through steam valves controlled by an electronic device with a moisture-sensitive element located inside the return air duct.

Under automatic operation, the relative humidity in the building is varied in accordance with outdoor conditions to prevent condensation on the windows. With manual operation, the dial switch on the engineer's panel is set to maintain a constant humidity.



Exhaust fans are located in the roof penthouse and remove only enough air from the space to hold a positive pressure



Intakes of supply fans have vane control to vary the volume of air discharged to the three conditioned zone areas

The convector system is supplied with hot water because of its adaptability to automatic control. Water temperature is automatically varied with the outside temperature by indoor-outdoor controls which regulate the steam valves for the main heat exchanger.

There are three settings on the engineer's panel for convector water temperature control. The settings are Day, Night, and Manual. The Day setting automatically keeps the water between 90 and 210 F depending on outside temperature. The Night setting varies between 90 and 165 F. Under Manual control, any temperature is maintained.

Hot water flows to the convectors through one-pipe mains. Balancing fittings control the amount of water flowing to each radiator. Dial gages indicate supply and return temperatures.

Hot water for the convectors is supplied by two sets of steam heat exchangers. One set, located in the penthouse, supplies hot water for the upper five floors. The other set, for the lower five floors, is located in the basement tunnel. Steam condensate return pumps for each system are located with their respective converters.

An additional small steam converter in the tunnel supplies hot water for the booster heating coils. All steam converters are operated by a master selector switch on the engineer's panel. The controlled heat setting provides for building warm-up in the morning, but with indoor temperatures maintained above 65 F even in severest weather, there is little warm-up load.

To allow for the expansion and contraction of the convector water as its temperature changes, expansion tanks for the upper heating system are located in the penthouse.

Light Weight Aggregates Meet Construction Requirements

• Light weight aggregate substitution for sand and gravel to make concrete and plaster has been on the increase. The two materials most widely employed are vermiculite, a type of mica, and perlite, a volcanic glass. Both aggregates swell up when heated to give light concrete and plaster with excellent thermal and acoustical properties.

Expanded perlite and vermiculite weigh six to fourteen lb per cu ft, as compared with 160 lb for sand, gravel and stone. Although not suitable for heavy-bearing purposes, it is adaptable for roof and floor slabs, fill, plasters and fireproofing all steel construction. Structural steel must be insulated from fire or the heat makes sagging possible, with resulting building collapse.

If an 18-in. beam is fireproofed with perlite or vermiculite plaster and metal lath, the coating weighs only 20 to 30 lb per lineal ft compared with 220 to 240 lb for concrete using conventional aggregates. The difference can reduce the skeleton weight of a large building by as much as 30 per cent.

Thin interior partitions of light weight plaster over metal or gypsum lath increase considerably the usable space within a building. Six-in. curtain walls for fireproof structures use perlite in the outer shell and gypsum in the inner shell. Another advantage of this material is ceiling channels may be spaced farther apart when the plaster contains such fillers as the usual sand.

Perlite and vermiculite form nailable compounds. Vermiculite slab has been used in radiant heating systems where its nailability results in lowered costs of installation, since pipes can be attached without drilling and bolting.

Vermiculite was first used for fireproofing skyscrapers in 1941, although its properties had been discovered in early 1922. It is mined principally in Montana and South Carolina. Perlite, unknown ten years ago, is mined in the West and was introduced on a substantial scale in 1946.

For load-bearing purposes cinder was the first medium weight aggregate and has given its name to this type concrete block. Another material, expanded clay, is made by mixing clay with coal or coke and burning it on grates to a temperature near fusing. As gas is developed, the mixture bloats to a viscous material, and then the cooled chunks are crushed to suitable size. In recent development work clay is extruded and cut into small pellets, then expanded in a rotary kiln. Expanded slag from blast furnaces is remelted and treated with steam to provide another type.

Industrial Bulletin

SPEED CONTROLS ON PUNCH PRESSES

Sixteen specially built punch presses were equipped with individual speed control units that gave a speed range of 100 to 250 strokes per minute. Fluctuation in stroke speed that caused a variance in product length is completely eliminated, and rejects are at the minimum

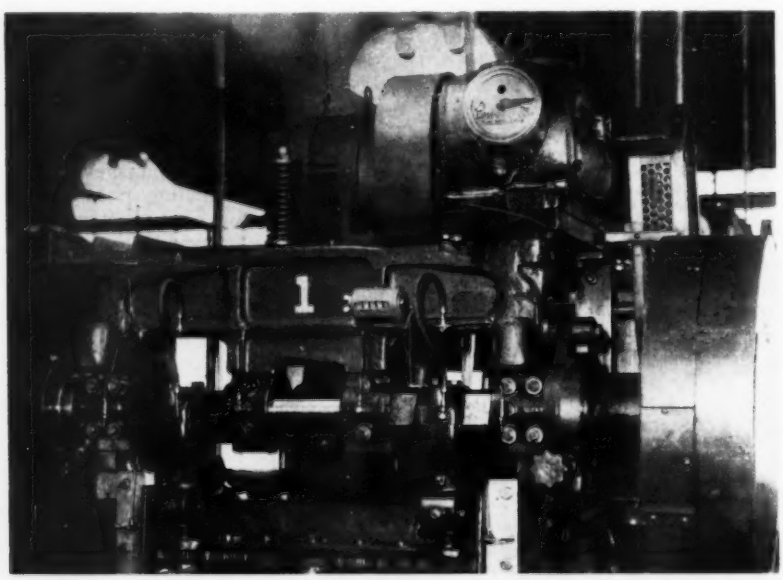
LOUIS KASPER, *Mechanical Supervisor, Steel Heddle Mfg. Co.*
FRANCIS A. WESTBROOK, *Mechanical Engineer*

HORIZONTAL variable speed units and motors are mounted on the top of each press. Infinitely variable speed regulation within the maximum and minimum press limit is therefore made possible when making the different heddle sizes.

Gear boxes with shift levers formerly changed the press speeds, but it was often not possible to obtain the exact speed desired. Also, stopping the machine was necessary when changing speeds. With the modern mechanical stepless variable speed control unit changes in speed, no matter how small, are easily, accurately and quickly made by merely adjusting a conveniently located handwheel, while the machinery is operating.

Input shaft of the variable speed unit is connected to the motor, and the output shaft to the press by positive-action, self-adjusting chain drives. Thus the speed will continue exactly as set by the handwheel, and indicated on the dial, until a new adjustment is made on the control.

Press operators are paid on an incentive basis. When properly set the presses will remain at that corresponding speed indefinitely, assuring the operator a satisfactory hourly rate of earnings. This is ideal from the standpoint of employe morale.



Horizontal mechanical variable speed control unit, located on top of this punch press, varies the stroke speed to accommodate product length to reduce rejects

Production has been increased as shutdown time is eliminated when changing speed. Starting the press at a low speed and building it up gradually while running is possible, if such a procedure should be advantageous. In addition, production has been increased as the result of reduction of down time caused by mis-feeds and the fact that maintaining a uniform speed assures a steady rate of output. Estimating the percentage of production increase attributable solely to the use of accurate speed control equipment would be difficult as other variables also affect the output.

The Steel Heddle Mfg. Co. of Philadelphia has equipped sixteen of their punch presses with mechanical variable speed drives. This change over has resulted in increased production, decreased maintenance costs, improved employe morale and numerous other advantages. Some 2000 different types of heddles are made by the company for the weaving of all kinds of cloth—from the heaviest duck to the finest silk and rayon fabrics. Consequently a high degree of versatility is required of its production machinery.

Heddles are made of flat steel wire of various lengths, depending on the kind of cloth to be woven. Holes are located at each end through which flat rods are run to support them in the loom. In addition there are holes in the middle through which warp threads are passed. The number of heddles in a loom depends upon the warp threads in a particular cloth of a given width. Thus, for a wide silk fabric, for example, a loom must have a large number of heddles.

Textile mills of any size at all that do weaving, must have several hundred looms. This naturally necessitates a very large number of heddles to be utilized, especially if a variety of cloths are produced. Consequently, leading heddle producers make this item on a quantity production basis. This explains the attention given to securing the most efficient operation of the punch presses that is practicable to obtain in production.

Sixteen specially built automatic presses are equipped with variable speed drives. Each is driven by an individual 7½-hp constant speed motor. These automatic punch presses are op-

INCREASE OUTPUT AND REDUCE COSTS

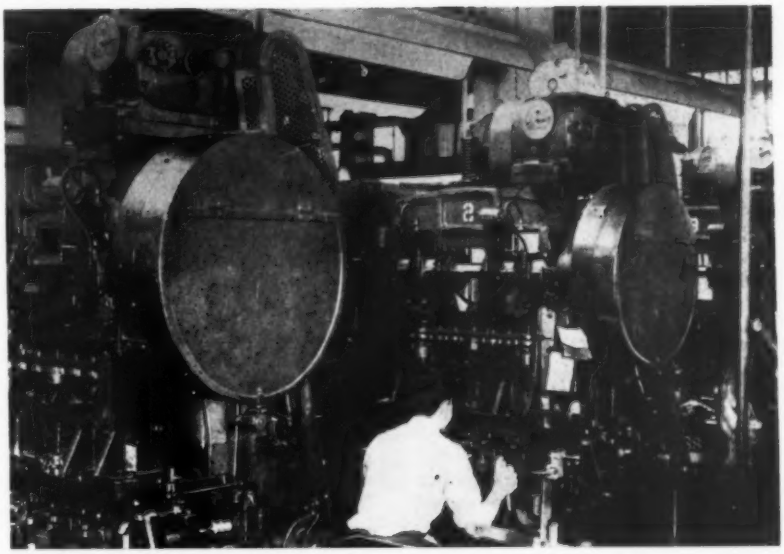
erated through a speed range of 100 to 250 strokes per min, depending on the type of heddle being made.

As these items must be accurately made, accurate control of the speed is very important. Fluctuations in speed result in variations in the length of material fed through the presses. This, in turn, may result in damaged dies due to mis-cuts.

Maintenance of the dies has been decreased by the reduction in number of mis-cuts. This, furthermore, influences product quality insofar as it is affected by condition of the dies.

Variable speed control units are also easy to maintain as they are totally enclosed in compact, oil-tight housings which provide for splash lubrication.

Fifteen of the variable speed units installed are of the horizontal type. The sixteenth is a vertical unit, selected because of space limitations. It is equipped with remote electrical control and a tachometer for adjustments.



Hand wheel on side of speed changer can be set to fit any condition by operator assuring a perfect cut, increased production, low overhead and satisfied workers

Variable Pitch Drives Increase Production

● Motion-control variable pitch drives are being used in the Hawkins mine of the Cleveland Cliffs Iron Co. to automatically regulate the speed of feeders in the mine's ore pit and wash plant.

This ore pit feeder controls the rate of feed to the scalping screen. The drive consists of a motion-control variable pitch sheave, a companion sheave, four V-belts, an automatic motor base and one locking bar mechanism. This varies input speed from a 20-hp, 865-rpm motor to a gear reducer from 700 to 865 rpm.

Automatic wide-range variable pitch drive on the pan feeder in the wash plant supplants a mechanical speed reduction unit. Prior to the installation of the variable speed controls, the constant speed was 24 rpm and loading of the feeder had to be regulated according to the needs of the wash house.

Speed range of the wash house conveyer is 18 to 36 rpm, while the output speed on the conveyer head shafts varies from 5.4 to 10.26 rpm.

Motion control variable pitch drive is automatically operated by the positioning device in foreground. Sheaves are opened and closed to obtain any desired speed

HEATER CARE PRIOR TO HEATING SEASON

Numerous industrial plants throughout the country utilize unit heaters for summer ventilation. Even though heating systems were checked in the early spring here are a few hints to insure efficient winter operation

IN MANY PLANTS across the country, maintenance crews equipped with brushes, pipe wrenches, oil cans and air guns are checking up on unit heaters prior to the heating season. In numerous plants, where unit heaters are installed, these units are used for summer air circulation to provide comfort for working personnel. During this period there is bound to have been some accumulation of dust upon the fin surfaces of the coil, motor and heater casing. Before actual heating operations are under way, the heater assemblies should be thoroughly checked.

Important points to check during this inspection are coils, motor, casing and loose connections to prevent excessive vibration.

Motors

All grease and dirt should be removed from the outside of the motor. During this cleanup job, a thorough inspection of the fan blades should be made. In case there is an excess dirt accumulation on the blades, they should be thoroughly cleaned to prevent unbalancing, which results in excessive noise and motor bearing wear.

In checking the motor for lubrication, the previous maintenance records should be reviewed. Manufacturers of both ball and sleeve bearing motors ship these units with sufficient lubrication to last for at least one year's operation. The motors should be repacked only after 2,000 hours of operation. One common fault in servicing all motors is overlubrication. Continued lubrication will damage the windings and motor failure will result.

Condensers

Adverse atmospheric conditions in certain industrial plants are detrimental to the operating efficiency of the units. Air, laden with lint, dust and various types of foreign matter will clog up the air passages through the unit, reducing heat transfer and air volume. In addition to this lowered efficiency, there is a definite strong odor when the steam is supplied to the coil.

After a thorough inspection and the degree of the cleaning job is anticipated, one of three methods can be employed. If the unit is fairly clean and the dirt appears to be loose, only brushing the fins is necessary. However, in brushing the fins, best results have been accomplished from the air entering side. After the particles have been freed the fan is turned on, and this dirt is blown from the fin surface.

As the force of the air leaving the fan blades is not great, a stream of air from a high pressure hose is sometimes necessary. In extreme cases, air under pressure is blown through the front of the heater, the air leaving side, and directed at any points that need to be cleaned. When using high-pressure air from the air outlet side, be sure to clean the fan blades before the unit is returned to operation.

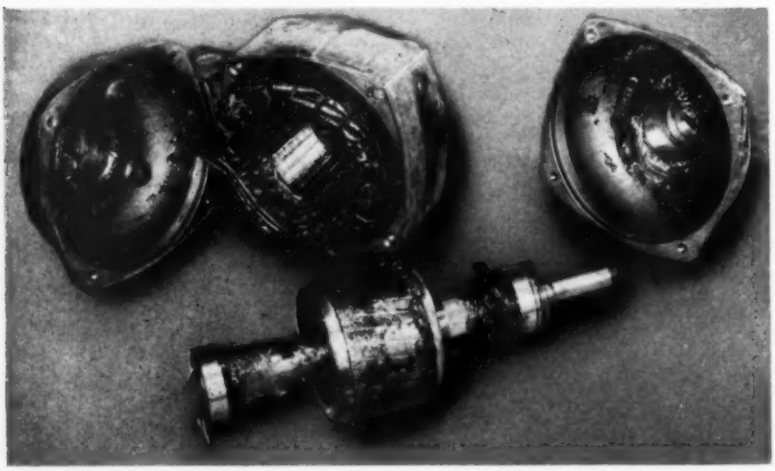
When the heating coils cannot be thoroughly cleaned either by brushing or a high velocity air jet, cleaning can be done with a mild alkaline cleaning solution spray. When such a spray is used, the motor must be removed from the unit. The spray gun should be directed at the air entering side of the unit and completely bathed. A piece of lightweight canvas should be draped over the heater to catch the cleaning solution, and the fluid can be directed to a pan under the heater.

After the heater has been completely cleaned, high pressure air should be used to remove all dirt particles. Rinsing is accomplished with steam or sprayed with fresh water. After the rinsing process, either the fan is turned on or high pressure air is used for assuring complete drying.

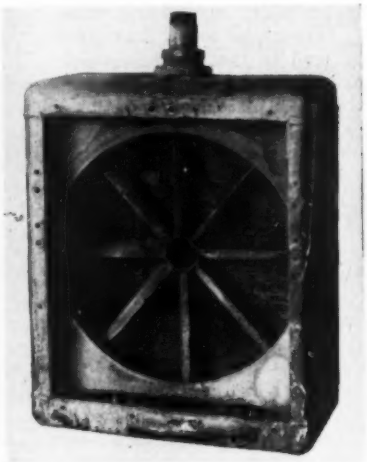
Casing

During the cleaning of the coil, the casing should be inspected, and if dirt, grease and corrosive substances have accumulated, cleaning is essential. Rusted or corroded spots should be repainted after the cleaning job.

Courtesy of Modine Mfg. Co.



Result of over lubricating a unit heater motor. Grease has worked through both bearings and destroyed the effectiveness of the windings causing motor failure



Accumulation of dirt on heater fins reduced efficiency and caused bad odors

Self-Contained Packaged Steam Generators

Factory assembled with all auxiliaries and push-button controls, these units are shipped to plants as a package and are ready for quick low-cost installation. They will deliver efficiencies over 80 per cent when carrying loads from one-third to full rated capacity

SUPPLYING steam for heating and process operations in commercial, industrial and military establishments has always presented problems for which a self-contained boiler with a high degree of performance has proved to be the ideal solution. Such a steam generator is an assembly incorporating the boiler proper, the boiler trim, fuel preheater, fuel burner, draft fan, feedwater unit, and operating and safety controls. It it built under the responsibility of a single manufacturer and pretested at the factory, thereby permitting peak co-ordination of the boiler components. Shipped completely as assembled, it can be installed with a minimum of construction, and usually requires connection only to steam, fuel, water and electrical service outlets.

The so-called packaged idea was first applied about 16 years ago to portable equipment for the construction industry where the self-contained features and ready ability to put the equipment into service are primary requisites. The boilers were used for heating oils, asphalts, concrete aggregates, and for pile driving. Immediately following success in this field, stationary types were built for industrial applications requiring high-pressure steam, and this was followed shortly with designs for the lower steam pressures required in the heating field. A cutaway view of a high-pressure unit and nomenclature of its component parts are shown in Figs. 1 and 2, respectively.

Wartime Applications

Both the portable and stationary types of the self-contained packaged boiler played an important part in the last war. Thousands of them were applied to a variety of duties for which self-contained equipment has no equal.

Military applications included boilers for hastily erected camps and training centers, as well as for road and airport construction. Marine installations included boilers for galleys, hot-water heating, and ship heating on diesel-propelled vessels. Other branches of the service applied these units for ship service, sterilization, cooking, ice melting, portable laundry and dry-cleaning plants, sea-water distillation, hospital service, and emergency hangars. Obviously the stationary applications far outnumbered those in the portable field.

In all these military applications, careful attention was directed to design in order to provide a rugged and simple construction with maximum savings in weight and space, and at the same time retaining high capacity, low maintenance and maximum economy of operation. Present-day stationary self-contained boilers have benefited tremendously by this extensive experience. Their features were proved under conditions far more extreme than normally encountered in industry, which helped the manufacturer to eliminate

Special INDUSTRY & POWER report for the Plant Engineering Group

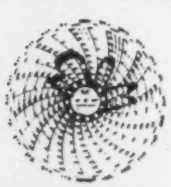
THEY HAVE THESE ADVANTAGES

SELF-CONTAINED—Includes boiler, burner, electrical controls, piping and auxiliary equipment, all designed or furnished by a single manufacturer. Constructed in accordance with ASME code requirements and pretested at factory before shipment. Permits good arrangement and appearance of components and auxiliaries. All components selected so that each works in proper relation to other parts of the assembly; therefore, the boiler develops high overall efficiency with maximum simplicity of operation.

COMPACT—Simple construction offers maximum savings in weight and space. Can be transported to point of use and installed with minimum field labor. They require low headroom, make for clear aisle space in boiler room, and fit many unusual space situations in existing plants. Permit economical construction of new boiler plants with boiler rooms of small cubical content. Packaged boilers are mounted on rugged frames, which greatly simplifies installation. Boiler components and auxiliaries are arranged to permit easy inspection, testing and servicing.

FAST INSTALLATION—No special foundations are needed; existing concrete floors usually suffice. Can be placed in operation on short notice and under irregular operating conditions. They are readily moved as required by plant expansion or plant relocation. They do not require brick or steel chimneys; pipes of relatively small diameter alone are needed to vent gases to the atmosphere. Being factory assembled and factory tested, packaged boilers are readily connected to plant service outlets.

AUTOMATIC OPERATION—For gas or fuel oils up to No. 6 or Bunker C, semi- or fully-automatic ignition is provided. Interlocked electrical controls operate the burner proper, blowers, low-water cutoff devices, and feedwater supply; thus, boiler operates automatically to meet varying load requirements. Burner controls provide favorable ignition and combustion characteristics at high air pressure and velocity. Automatic controls provide quick-starting characteristics, reduce the amount of labor required for high degree of regulation, and contribute to low steam costs.



QUICK STEAMING—Boilers can be put on the line at full fire in minimum time. Intermittent or fluctuating loads are handled readily. Heat losses are minimized when loads fluctuate widely, and when plant is shut down. They provide heat and process steam for light or variable loads in industrial plants, and will operate above 80 per cent efficiency from 25 to 100 per cent of rating. There are no banking losses to offset high efficiency. Seasonal loads are easily handled. Operating costs are at the minimum.

CLEAN—Because of high combustion efficiency, little or no smoke is emitted from exhaust vent or stack. No need for high smokestack. They insure clean and efficient operation, and help operators meet smoke-abatement ordinances. Boiler-room problems are simplified in plants requiring high standards of cleanliness. Excellent working conditions, good sanitation and clean working areas are provided, making for "show-place" boiler rooms that give personnel peak incentive for maintaining the equipment.

weaknesses and less reliable features of the equipment.

The present field of the packaged steam generator might be divided into three categories: (1) The so-called commercial or small industrial field with steam loads up to 3,500 lb per hr; (2) The middle industrial field with loads from 3,500 to 20,000 lb of steam per hr; and (3) a field of larger industries with steam requirements between 20,000 and 90,000 lb per hr, and where, for the latter loads, multiple-boiler installations are required.

Ratings and Capacities

Both fire-tube and water-tube packaged steam boilers are available for use in the industrial and commercial fields. All are designed for use with gas or oil fuels. It is necessary to employ a wide range of designs to meet varying contract specifications and comply with the numerous field applications of the equipment. The variables involve a series of steam working pressures, oil-burner capacities, types for the grades of oil used, features of the automatic control system and its electrical current characteristics, and application of the various safety controls.

Manufacturers rate their boilers on the maximum amount of steam their units will generate, usually at a guaranteed efficiency and steam quality. However, fire-tube boiler manufacturers often stipulate ratings in horsepower with the 1 hp being equivalent to the evaporation from and at 212 F of 34.5 lb of steam per hr. Ratings based on 10 sq ft of heating surface per boiler horsepower are obsolete.

Ratings and capacities of fire-tube packaged steam generators range from 10 to 500 hp, with equivalent evaporation capacities of 345 to 17,125 lb of steam per hr, respectively, at 100 per cent rating. These and other pertinent data on self-contained boilers of fire-tube design are given in Table 1. Relative sizes of the boilers are indicated in Fig 3.

Water-tube packaged boilers, which are available with steam capacities up to 30,000 lb per hr, are discussed in a subsequent section of this article.

Fire-Tube Boilers

Fire-tube types of packaged boilers from 10 to 600 hp are built for operating pressures ranging from 15 to 300 psig. Low-pressure types for commercial plants are available down to 10 hp weighing about 800 lb, while an industrially designed boiler of the same rating may weigh as much as 2,300 lb. Industrial fire-tube boilers of 500 hp rating will weigh up to 33 ton.

Early designs of these packaged boilers were fired with No. 3 fuel oil. Today, about 15 per cent of the total fuel

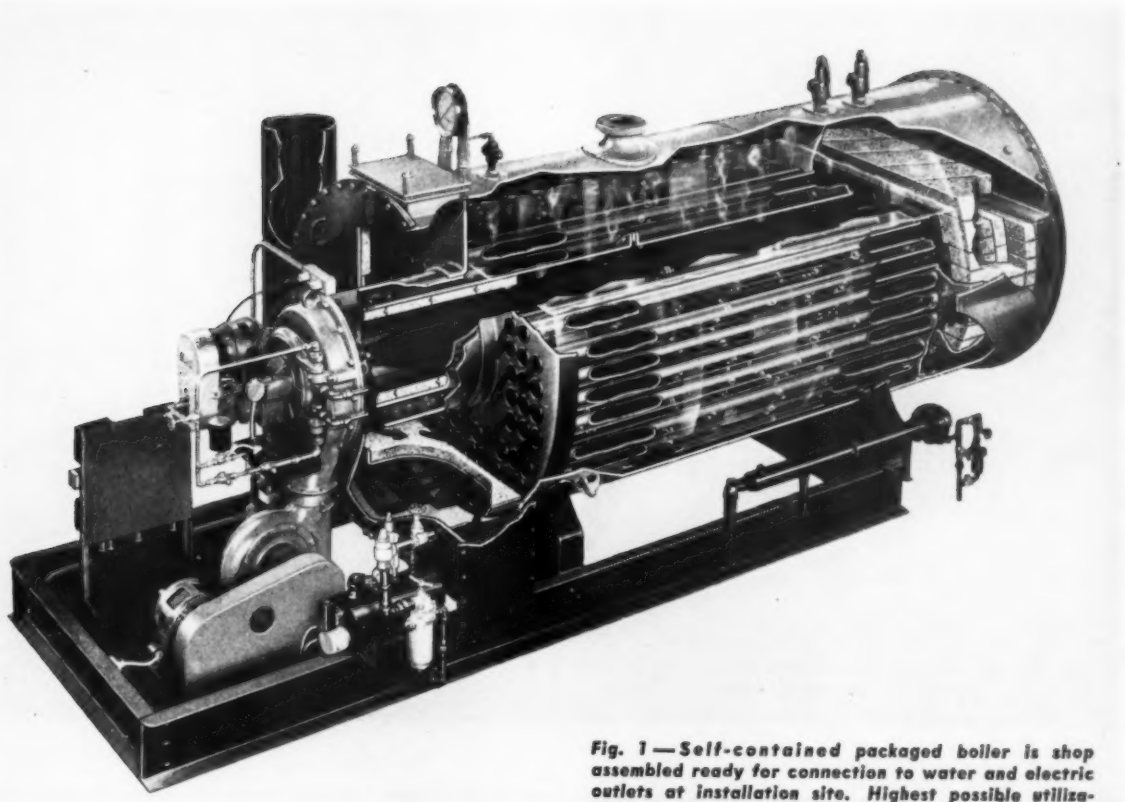


Fig. 1—Self-contained packaged boiler is shop assembled ready for connection to water and electric outlets at installation site. Highest possible utilization of heating surface makes compact design

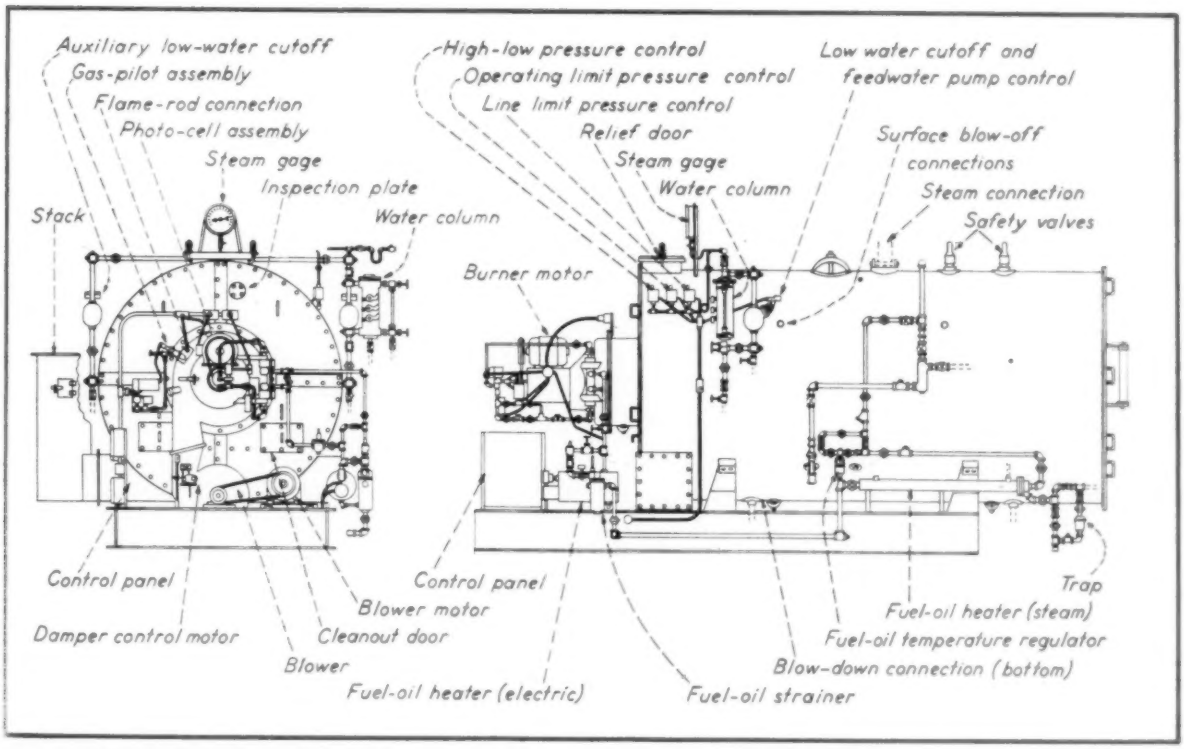


Fig. 2—Nomenclature for typical self-contained fire-tube packaged boiler. Boiler proper, boiler trim, operating and safety controls, and auxiliaries are all mounted on box channel frame. Boilers are easily conveyed to installation sites

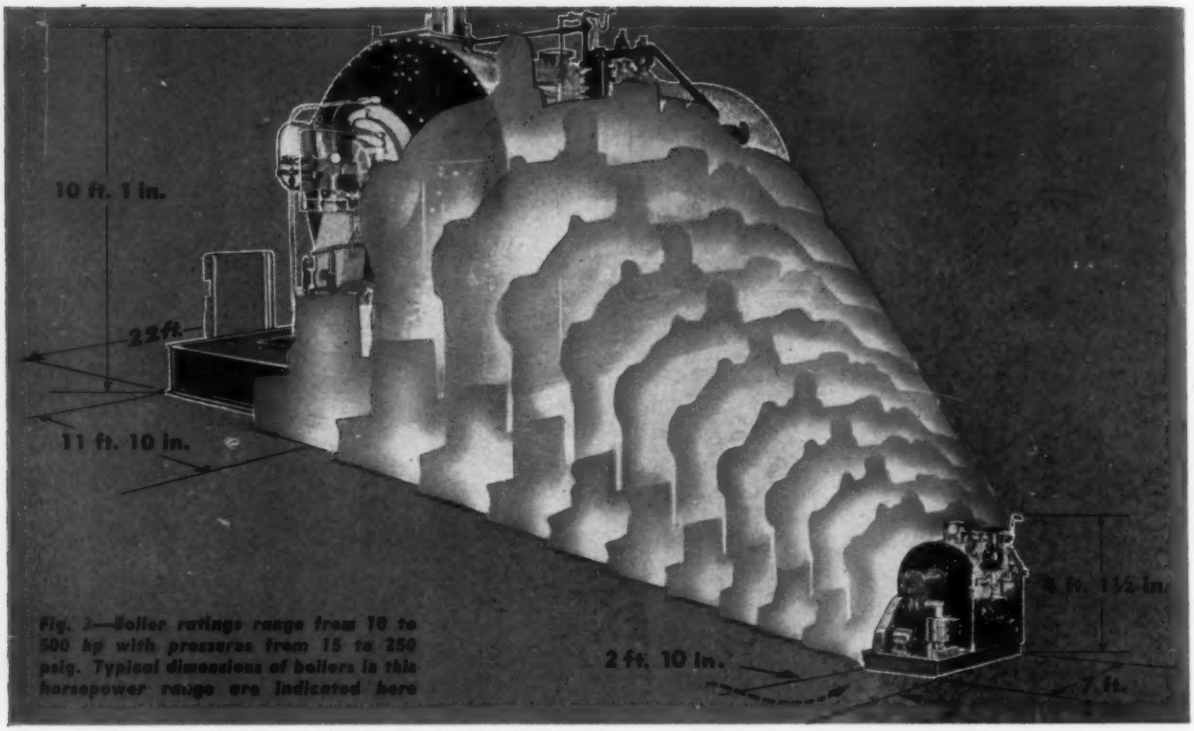


Fig. 3—Boiler ratings range from 10 to 500 hp with pressures from 15 to 250 psig. Typical dimensions of boilers in this horsepower range are indicated here

TABLE 1—COMPOSITE DATA FOR SIZES, CAPACITIES AND FUEL CONSUMPTION OF HRT SELF-CONTAINED STEAM GENERATORS

Boiler horsepower	20	30	40	50	60	70	80	100
Rated capacity, lb steam per hr (212 F)	700	1,050	1,380	1,725	2,070	2,420	2,760	3,450
Equiv. direct radiation, steam, Btu	2,780	4,170	5,560	6,950	8,340	9,370	11,120	13,900
Equiv. direct radiation, water, Btu	4,460	6,690	8,920	11,150	13,380	15,610	17,840	22,300
Heat input at capacity, 1000 Btu/hr	850	1,250	1,680	2,100	2,500	2,940	3,350	4,200
Furnace volume, cu ft	9.3	11.9	15.5	18.2	20.5	24.0	26.3	30.4
Heat release, Btu per cu ft	93,500	106,000	108,000	115,000	123,000	123,000	128,000	138,000
Oil consumption at rated capacity:								
No. 6 oil, gph	5½	8	11	14	16	19	22	28
No. 3 oil, gph	6	9	12	15	18	21	24	30
Gas consumption at rated capacity:								
500 Btu, mfgr., cu ft per hr	1,700	2,500	3,360	4,200	5,000	5,880	6,700	8,400
800 Btu, mixed, cu ft per hr	1,050	1,570	2,100	2,620	3,150	3,680	4,200	5,250
1000 Btu, natural, cu ft per hr	840	1,250	1,680	2,100	2,500	2,940	3,350	4,200
Heat output at capacity, 1000 Btu/hr	670	1,000	1,340	1,670	2,000	2,350	2,675	3,345
Dimensions:								
Boiler diameter, inside, in.	42	44	50	49	49	55	55	58
Boiler shell length, in.	72	94	94	112	123	121	133	140
Length over-all, in.	110	126	137	150	168	156	174	192
Width over-all, in.	60	69	74	75	78	84	84	89
Height over-all, in.	60	68	70	73	75	79	80	85
Shipping weight, lb	5,584	6,480	8,960	9,140	11,000	11,400	12,550	15,750

Boiler horsepower	125	150	200	250	300	350	400	450	500
Rated capacity, lb steam per hr (212 F)	4,310	5,200	6,900	8,625	10,500	12,000	13,800	15,500	17,125
Equiv. direct radiation, steam, Btu	17,375	20,850	27,800	34,750	41,700	48,650	55,600	62,500	69,500
Equiv. direct radiation, water, Btu	27,875	33,450	44,600	55,750	66,900	78,050	89,200	100,300	111,500
Heat input at capacity, 1000 Btu/hr	5,250	6,300	8,400	10,500	12,600	14,700	16,800	18,900	21,000
Furnace volume, cu ft	37.5	39.4	52.4	62.2	70.1	73.7	102.6	110.1	119.4
Heat release, Btu per cu ft	140,000	160,000	160,000	169,000	140,000	155,000	138,000	128,000	132,000
Oil consumption at rated capacity:									
No. 6 oil, gph	35	41	55	69	83	96	110	124	138
Gas consumption at rated capacity:									
500 Btu, mfgr., cu ft per hr	10,500	12,600	16,800	21,000	25,200	29,400	33,600	37,800	42,000
800 Btu, mixed, cu ft per hr	6,580	7,900	10,500	13,100	15,800	18,400	21,000	23,600	26,200
1000 Btu, natural, cu ft per hr	5,250	6,300	8,400	10,500	12,600	14,700	16,800	18,900	21,000
Heat output at capacity, 1000 Btu/hr	4,200	5,020	6,690	8,365	10,040	11,710	13,390	15,100	16,740
Dimensions:									
Boiler diameter, inside, in.	63	66	73	84	85	92	96	99	97
Boiler shell length, in.	156	157	168	170	192	195	208	217	218
Length over-all, in.	198	210	231	233	252	270	276	294	300
Width over-all, in.	96	100	114	121	122	144	145	162	162
Height over-all, in.	87	93	99	114	118	120	126	132	132
Shipping weight, lb	18,500	21,000	24,900	32,050	36,500	40,900	46,300	51,250	54,000

NOTE: Data in this table are compiled from information and statistics supplied by the boiler manufacturers listed on the concluding page of this article. Boiler dimensions and shipping weights are averages. Performance data are applicable up to 3,000 ft elevation.

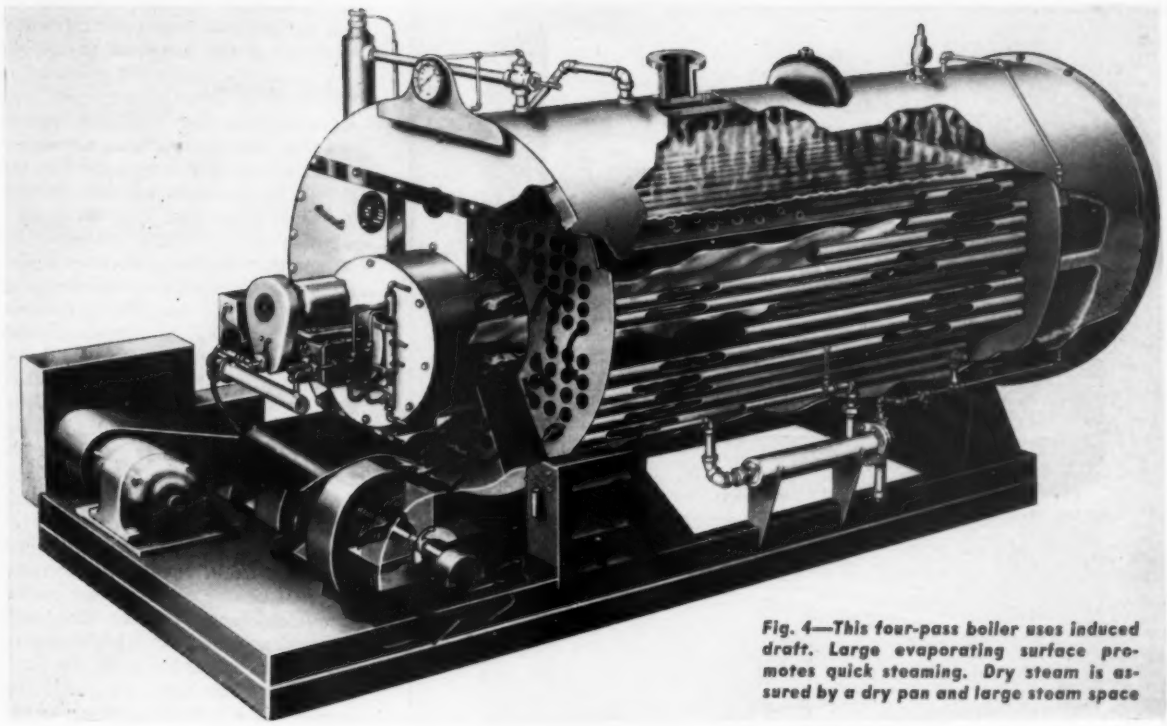


Fig. 4—This four-pass boiler uses induced draft. Large evaporating surface promotes quick steaming. Dry steam is assured by a dry pan and large steam space

burned in the boilers is No. 3 oil, the balance being Nos. 5 and 6 oil. There is an increasing use of gas fuel.

In attaining maximum efficiency from burning these fuels, the boilers are built to absorb the maximum amount of heat practicable. And, in turn, the high utilization of heating surface makes for a compact design, which means it occupies less floor space.

Each boiler has an integral furnace, and employs more tubes than the customary type of horizontal return tubular unit; at the same time, the number of passes is increased to obtain long gas travel and better heat absorption. These characteristics are illustrated in Figs. 1, 4, 6, 7 and 8. In many types, the integral furnace is usually of flat-sheet design, while in others corrugated sheets are utilized to increase furnace strength and heating surface area.

High heat transfer or scrubbing of the heating surfaces is obtained by passing the hot gas through the boiler at high velocities. This is done by forced or induced draft. Mechanical draft also takes care of the somewhat higher pressure losses of the multi-pass design, and eliminates need for stack draft—all that is needed is a vent or duct to remove flue gas.

Boiler Efficiencies

Since packaged boilers are designed to extract the maximum amount of heat from a cleanly burned fuel, they actually deliver a flat or uniform efficiency over a wide load range. Flat efficiencies of 80 per cent or over between 33 and 100 per cent of maximum ratings are everyday occurrences. Actually, the efficiency is established before the boiler is shipped from the factory, and it is one that can be maintained with relative ease after installation. High operating efficiency permits the use of fuels like oil and gas, which have a higher unit cost, but which can compete successfully with lower-cost fuels normally handled at low efficiencies.

Efficiency curves for both small and large boilers, as well as curves for average stack temperatures and average CO_2 content of flue gases, are shown in Fig. 5. Performance characteristics, as established from a number of certified tests, are revealed by data in Table 2 on page 83.

High efficiencies at variable loads, without significant losses occasioned by shutdown or banking, is one of the primary advantages afforded by most self-contained packaged steam generators. The average installation has no 24-hr continuous load. Instead, the load is most irregular. Process-steam loads range from 8 to 10 hr per day, and have characteristic peaks at the beginning of each day. In many plants, interruptions to process loads are not uncommon so that intermittent loads are followed immediately by what is equivalent to full starting load with little or no diversity. Under such conditions, maximum efficiency between low and maximum rating of the boiler is of extreme importance.

Design Variations

By types, self-contained packaged boilers of fire-tube design can be classified as follows: water-back or dry-back; forced draft or induced draft; two-pass, three-pass, or four-pass; gun-type burner or horizontal rotary-type with direct drive or belt drive; gas-electric, or oil-electric or manual ignition; thermostatic stack control or photoelectric cell instantaneous flame-failure control; motor modulation to adjust firing rate to meet variations in steam demand, or "on and off" control by steam pressure; and electric preheater or steam heater, or both. This list does not include auxiliaries, safety equipment or instruments commonly furnished as regular equipment. Nor does it include special equipment needed for burning heavy oil, or to meet some unusual working condition.

All of the components of the packaged steam generator are selected and applied so that each works in proper relation to the other parts of the assembly. Therefore, it develops its high over-all efficiency with maximum simplicity of operation.

By mounting it on a rugged frame, installation is simplified greatly. No special foundations or brick settings are

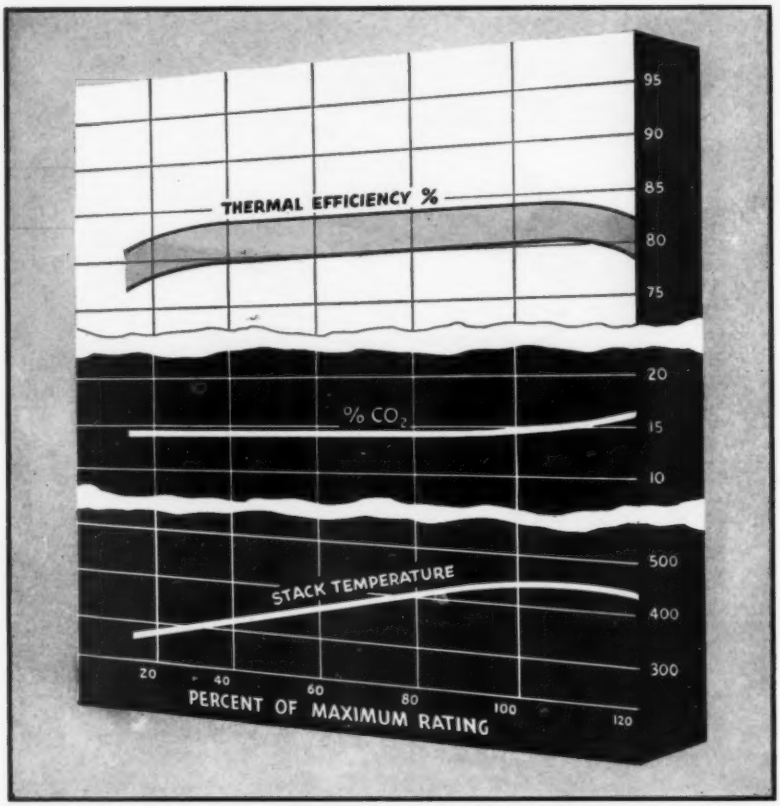


Fig. 5—Boilers deliver uniform efficiency over wide load range. Thermal efficiencies of 10 to 500 hp units fall within the efficiency band shown here

required; nor are brick or steel chimneys—vent pipes of relatively small diameter are all that is needed to vent gases to the atmosphere.

The design of these boilers involves the choice and location of the refractories and insulating materials so as to obtain maximum benefits without extreme weight or bulk. Also, special attention is paid to the design of the base or supporting structure so as to accommodate the boiler and all its components, yet favor the subsequent shipping and handling of a complete unit.

Code Compliances

Self-contained packaged steam generators are, of course, built to conform to construction codes or regulations governing boilers in general. These include the ASME code on boiler construction, National Board of Pressure Vessel Inspectors rules on inspection and safety, Underwriters Laboratories codes on electrical devices and performance, and National Electrical Manufacturers Association code.

Boiler components and auxiliaries are mounted to meet recent demands by boiler inspectors and code authorities. The boiler itself is easily accessible for inspection and servicing both inside and out. For the same reason, all auxiliaries and working parts are in plain view. Typical of this policy are the hinged-back designs shown in Fig. 9. Here, the entire rear chambers swing back from the rear tube sheet to permit easy cleaning and inspection.

Operating Features

In co-ordinating the boiler unit with fuel-burning equipment and other related accessories, certain important operating advantages are achieved by the self-contained steam generator. Included is close combustion control unaffected by atmospheric conditions, giving the two ingredients which provide and define efficiency: the ability to burn fuel completely with minimum excess air, and absorb the maximum amount of heat under various loads.

Packaged boilers inherit a number of their advantages from the characteristics of oil and gas fuels. These include a ready adaptability to automatic or wide-range burning, the relative cleanliness in handling and burning such fuels, and in general a reduction of operating labor.

There are a number of features that contribute to low maintenance costs, including the use of co-ordinated high-quality components and auxiliaries, as well as the small amount of refractory employed in the design of the boiler.

Quick Starting

Inasmuch as the packaged unit is provided with automatic or semi-automatic controls, and is not subject to the combustion variables inherent in natural-draft equipment, it is obviously a unit that can be closely controlled by the operator. In connection with controllability, there is also the advantage of quick starting. In this connection, manufacturers do not recommend that the boiler be started up from cold and put on the line at full fire in a matter of minutes; quick-starting procedure is in the hands of the operator, and his experience must dictate the time involved to bring the boiler to full fire.

Aids Smoke Abatement

In operating the packaged boiler, direct attainment of smoke abatement must fall on the operator and on the type of equipment he uses. The packaged boiler, because of its high combustion efficiency and the particular fuels for which it has been designed, has proved that it can do as much if not more towards the elimination of the smoke evil than most other forms of fuel-burning equipment in the industrial field.

The numerous advantages offered by the packaged steam generator cannot be fully attained without the help of the operator. A good operator will apply himself to the study and handling of this mechanized boiler unit so that he can obtain the low operating and maintenance costs made initially possible by the designer. There is the further challenge to the manufacturer to keep building it better, to improve its safety, and to help educate the operator in the problems of service maintenance which accompany any type of modern equipment.

Association Comments

Even though packaged boilers offer a degree of control which can result in considerable labor saving, it is most unwise for the plant owner to regard modern automatic equipment as being totally free from supervision or preventive maintenance. In this regard, the present members of the Packaged Boiler Branch of American Boiler and Affiliated Industries have stated:

"Competent supervision of mechanical and electrical equipment in packaged boiler plants is necessary to maintain safe and reliable operation.

"One of the accepted values to the owner of a packaged steam generator is its operation by the use of automatic controls. Such controls reduce the amount of manual labor required, af-

ford a consistently high degree of regulation, and therefore contribute to the low cost of producing steam.

"In order to maintain these advantages, the manufacturers of packaged steam generators recognize that adequate supervisory maintenance is necessary and that automatic operations do not eliminate the need of operators."

Selection of Boilers

Before selecting a boiler, it is important to make a careful study of the proposed installation. The actual horsepower load must be determined. Complete knowledge of the total steam load is a necessity. The purchaser must know the number of hours the boiler will be used, and the maximum load at any period. He should then plan on installing a unit with a rating somewhat higher than the calculated load. However, some users select a boiler that is conservatively rated, and will develop some overload.

The plant engineer should calculate or measure the steam load in accordance with present-day accurate proce-

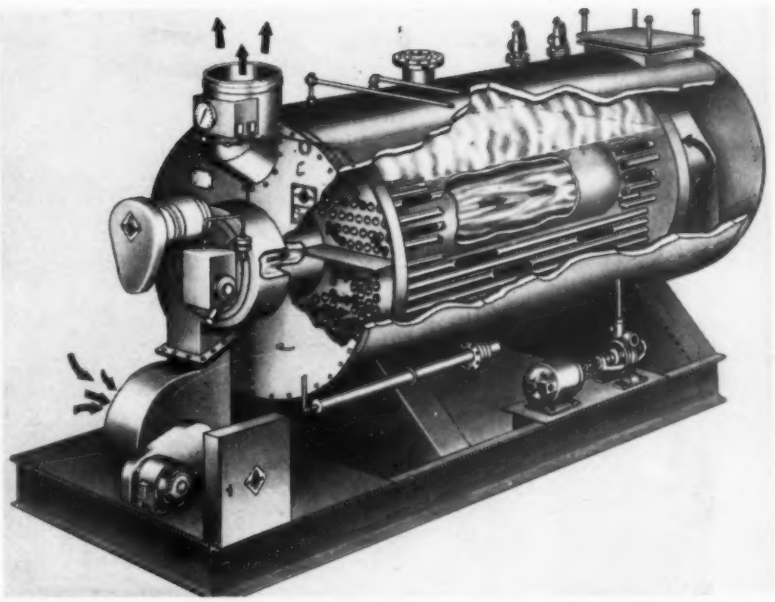


Fig. 6 — Four-pass boiler with forced draft. Packaged units are automatic in operation, using electronic operating, combustion and safety controls

TABLE 2—RESULTS OF PERFORMANCE TESTS ON HRT SELF-CONTAINED PACKAGE STEAM GENERATORS

Test Number	1	2	3	4	5	6	7	8	9	10	11
Boiler manufacturer's rating, hp	40	50	60	100	150	200	250	300	400	400	500
Design boiler pressure, psig	15	15	150	125	150	15	150	125	15	150	160
Duration of test, hr	4	4	1½	1	1	1	1	1	1	2	1
Boiler shell insulated	No	No	No	No	No	No	No	No	No	Yes	No
Steam pressure, average, psig	14	14	135	101	135	13	135	101	12	126	148.8
Temperature of stack gases, average, F	308	308	408	394	398	333	410	387	305	407	425
Temperature of feedwater, average, F	53	53	53	81.7	53	53	53	63	59	53	62
Boiler room temperature, average, F	58	58	66	73.7	80	66	80	73	68	—	77
Steam temperature at gage pressure, F	248	248	358	338	358	242	358	339	244	354	375
CO_2 content of stack gases, average, %	13.5	13.5	15.2	13.4	14	14.1	14	13.7	13.2	14.2	14.2
Air velocity at boiler shell, average, fpm (Note 1)	123	123	123	118	123	123	123	123	123	—	123
Heat content of oil, Btu per lb	19,416	18,743	18,906	18,622	18,689	18,689	18,689	18,703	19,512	18,703	18,780
Oil burned, lb per hr	89	116	146.6	250	342	440	548	699	830	957.7	1,065.5
Evaporation, meter corrected, gph	144	180	224	402	522	702	869	1,089	1,439	1,503	1,691
Weight per gallon of feedwater, lb	8.319	8.319	8.319	8.292	8.319	8.319	8.319	8.312	8.316	8.319	8.313
Evaporation, lb per hr	1,194	1,495	1,863.5	3,432.2	4,333	5,839	7,574	9,052	12,182	12,507	14,255
Area of uninsulated boiler shell, sq ft	84	133	75	172	242	279	317	377	454	—	525
Computations											
1. Heat loss, uninsulated shell, Btu/sq ft/hr/deg (Note 2)	3.20	2.60	3.45	2.76	3.11	2.60	3.11	3.37	2.52	—	3.26
2. Heat loss, insulated shell, Btu/sq ft/hr/deg (Note 3)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	—	0.19
3. Net heat loss, uninsulated shell, Btu/sq ft/hr/deg	3.01	2.41	3.26	2.57	2.92	2.41	2.92	3.18	2.33	—	3.07
4. Net heat loss, uninsulated shell, Btu/hr (Note 4)	59,088	74,908	95,332	116,300	241,628	146,163	318,510	392,243	228,997	—	590,771
5. Equiv. evap. from and at 212 F per lb of oil	16.47	15.80	16.04	15.71	16.08	15.93	15.80	16.04	16.85	15.77	16.20
6. Boiler hp developed	42.49	53.16	68.15	113.50	159.40	203.20	250.00	325.00	405.00	437.92	502.00
7. Thermal efficiency, %	82.31	81.90	82.31	82.00	83.80	82.70	82.00	83.20	83.50	81.84	83.00

Note 1—For effect of air velocity on bare surfaces, see Johns-Manville report IN-3,000.

Note 2—See "Naval Machinery," U. S. Naval Institute, 1941 issue, part 2, page 47, for heat loss from uninsulated boiler shell per hr per sq ft per degree of temperature difference between temperature at outside of boiler shell and temperature in boiler room. Little error is involved if steam temperature at gage pressure be substituted for temperature at outside of boiler shell; this eliminates the need for contact pyrometers during tests.

Note 3—For heat loss through 2-in. magnesia or equal—Btu per hr per sq ft per deg temperature difference between boiler shell and boiler room—see Johns-Manville test records.

Note 4—Formula: (Net heat loss from uninsulated shell per hr per sq ft of shell per degree temperature difference between boiler shell and boiler room) X (temperature difference between boiler shell and boiler room) X (boiler shell area, sq ft) X (1.23 which is allowance for air velocity around boiler). For this allowance, see "Naval Machinery," Naval Institute, 1941 issue, part 2, page 47; allowance for all tests in above table is 23 per cent increase in item No. 3 of the table—see sample calculations.

Sample Calculations — Test No. 1

4. Loss from uninsulated shell $= 3.01 \times 190 \times 84 \times 1.23 = 59{,}088$ Btu/hr

5. Equiv. evap. per lb oil $= \dfrac{1194 \times (1163 - 21) \text{ plus } 59088}{89 \times 970.3} = 16.47$ lb

6. Developed boiler hp $= \dfrac{1194 \times (1163 - 21) \text{ plus } 59088}{33475} = 42.49$ hp

7. Thermal efficiency $= \dfrac{1194 \times (1163 - 21) \text{ plus } 59088}{89 \times 19416} = 82.31\ \%$

Sample Calculations — Test No. 11

4. Loss from uninsulated shell $= 3.07 \times 298 \times 525 \times 1.23 = 590{,}771$ Btu/hr

5. Equiv. evap. per lb oil $= \dfrac{14255 \times (1195.4 - 30) \text{ plus } 590771}{1065.5 \times 970.3} = 16.20$ lb

6. Developed boiler hp $= \dfrac{14255 \times (1195.4 - 30) \text{ plus } 590771}{33475} = 502$ hp

7. Thermal efficiency $= \dfrac{14255 \times (1195.4 - 30) \text{ plus } 590771}{1065.5 \times 18780} = 83.00\ \%$

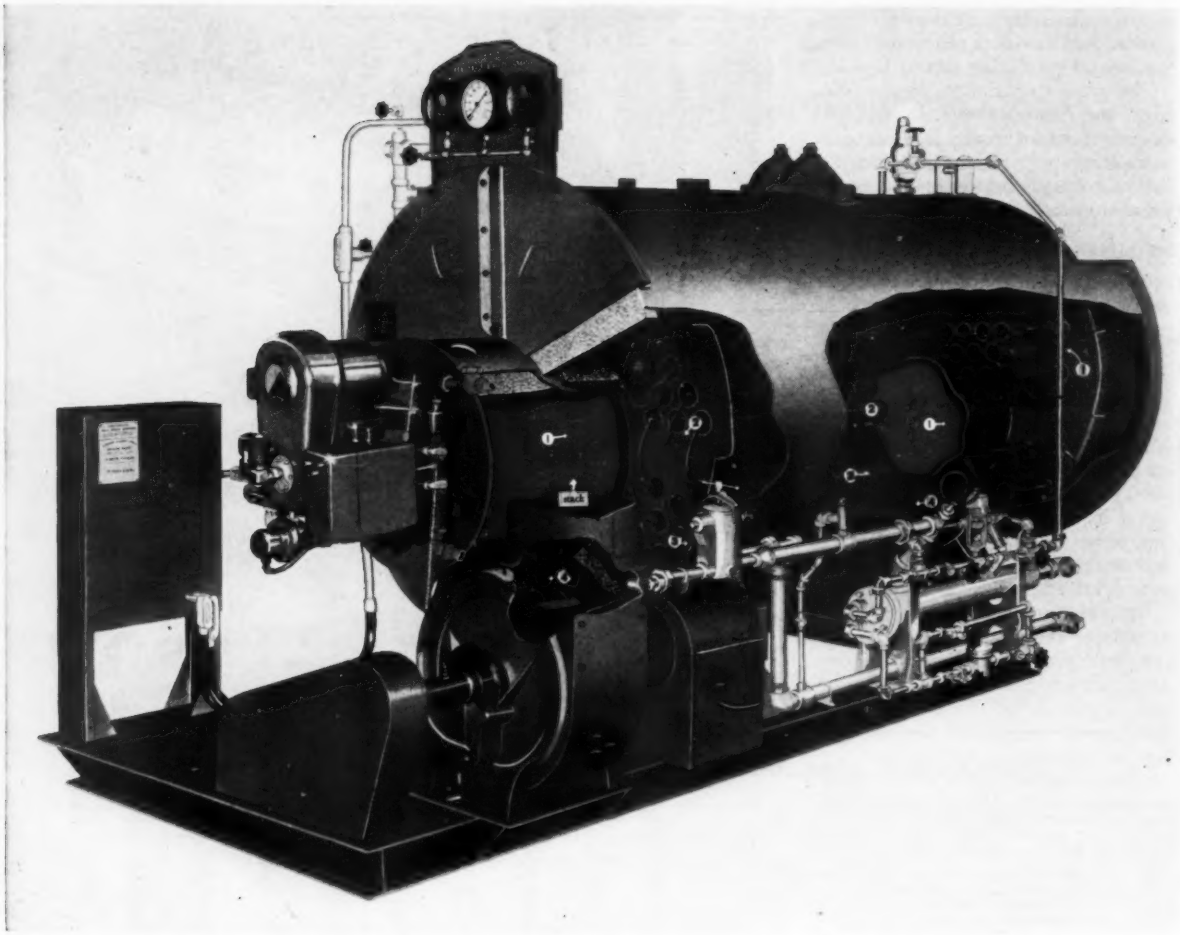


Fig. 7—Four-pass packaged boiler with induced draft and horizontal rotary oil burner. Units can be equipped for gas or combination gas-oil firing. Co-ordinated auxiliaries and small amount of refractory contribute to low maintenance

TABLE 3—EXAMPLES OF RECOMMENDED INSULATION THICKNESSES

Approximate boiler hp	Boiler shell dimensions			Insulation thickness, in. for the following working pressures:		
	diameter	length	area, sq ft	To 15 psi	15-125 psi	125-200 pis
15	30"	4'-5"	35	1	1¼	1½
30	43"	8'-9"	99	1	1¼	1½
30	37"	6'-3"	60	1	1¼	1½
50	49"	9'-6"	123	1	1¼	1½
50	43"	8'-9"	99	1	1¼	1½
60	49"	10'-8"	138	1	1¼	1½
80	55"	11'-2"	161	1	1¼	1½
80	49"	11'-4"	142	1	1¼	1½
100	55"	12'-9"	184	1	1¼	1½
120	61"	13'-2"	211	1½	1½	2
120	55"	12'-3"	165	1½	1½	2
150	67"	13'-5"	236	1½	1½	2
150	55"	14'-3"	192	1½	1½	2
200	73"	14'-8"	282	1½	1½	2
250	85"	14'-4"	320	1½	1½	2
300	85"	16'14"	364	1½	1½	2
350	92"	16'-2"	390	1½	1½	2
400	98"	14'-7"	374	1½	1½	2
500	98"	17'-2"	440	1½	1½	2

NOTE: To conserve heat and improve efficiency, one packaged-boiler company recommends the above insulation thicknesses for its units. The shell should be completely covered between the head flanges. Insulation should be applied up to the boiler saddle support web, and beveled at manholes and at steam nozzle flanges. The following materials are suggested: (1) 85 per cent magnesia insulation block of thicknesses listed above; (2) 1½-in. mesh galvanized chicken wire; (3) rough coat asbestos cement ¼ in. thick; (4) finish coat asbestos cement ¼ in. thick; (5) 8-oz. canvas jacket pasted on; (6) filler and finish paint as desired.

dure. In addition to calculating the heating load carefully, he should add calculated figures for hot-water heating and any process heating that may be required. Allowance should then be made for reasonable pickup in the case of the fast-steaming packaged generators. Finally, reasonable allowance should be made for future plant expansion. When these items are glossed over or approximated, it is a dangerous thing to size closely a boiler or any other piece of equipment.

The following factors also enter into boiler selection: seasonable load variations, night shutdowns, week-end shutdowns, the variable effect of the heating load which is combined with the processing load in most plants, the problems of condensate return, attention to the character and treatment of feedwater, as well as problems of proper blowdown, storage of fuels, the handling of fuels, and the problems peculiar to the firing of gas and heavy oils.

A prospective purchaser should also ascertain the first cost of the boiler,

calculate or estimate maintenance cost, consider the use of firing equipment that will burn fuels at high efficiency, ascertain probable banking or stand-by losses, and figure operating labor costs. Installation costs must also be considered, including those for insulation (see Table 3), foundations, masonry, chimneys and other elements of the buildings, with true evaluation given to savings in space made possible with small high-capacity boilers.

Installation Hints

While the exact location of the installed boiler depends on many factors, it should be placed with due regard to operating considerations. Maximum practicable clearance for accessibility of manholes, handholds, and blow-off cocks should be provided. Ample aisle space is usually desirable along the front end of the boiler frame.

It is important to provide clearance equal to the length of the fire tubes at the front or rear of the boiler; this permits removal and cleaning of tubes. Such clearance can sometimes be obtained by installing a door in the building adjacent to the boiler. When this is done, the boiler should be far enough from the building door to permit opening or removal of boiler doors.

Most boilers are constructed with two saddle supports, built into a box channel frame. With such a design, the complete steam-generating unit may usually be grouted on a concrete floor without need for a special concrete slab or extra foundation. However, in some cases it is desirable to set the boiler on piers under each saddle and the front burner extension to raise the channel frame 2 to 6 in. above the floor level. This is considered particularly desirable with small boilers in order to raise the burner to a convenient height.

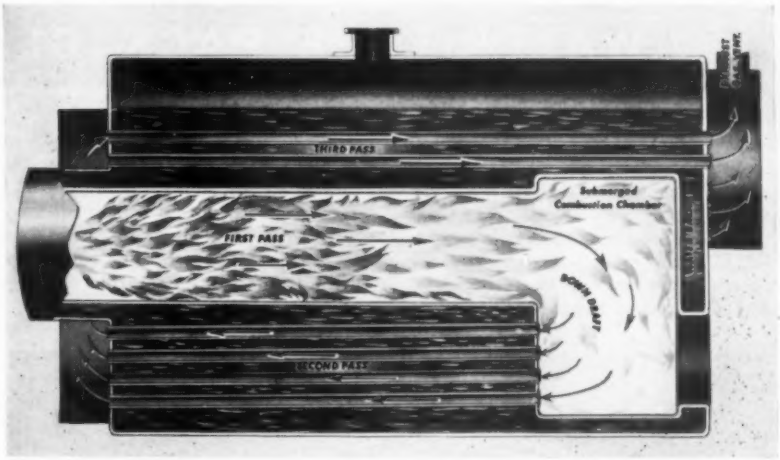


Fig. 8—This three-pass wet-back boiler utilizes a water leg instead of refractory at the submerged combustion chamber

Mounting the boilers on piers not only facilitates draining, but also the sweeping of the area inside the box frame. If piers are not used, it is often recommended that the channel frame be shimmed up with ¼-in. steel plate, using at least three shims to each side of the frame, plus additional shims under the boiler saddles and the end of the frame.

The boiler must, of course, be set exactly level. When this has been done, the clearance space under the frame must be packed with stiff cement grout. Usually, an opening about 4 in. wide is provided through this grouting on each side of the frame to permit water drainage when washing out the boiler. Some boiler plants use a catch basin and floor drain inside the frame and directly under the boiler to dispose of wash-out water.

Stack connections attached to the packaged boiler's vent stub must be of adequate size and as direct as possible. The stack must extend at least to a height that will positively eliminate downdraft. Adequate structural support should be given the stack, rather than to let the boiler vent stub carry all its weight.

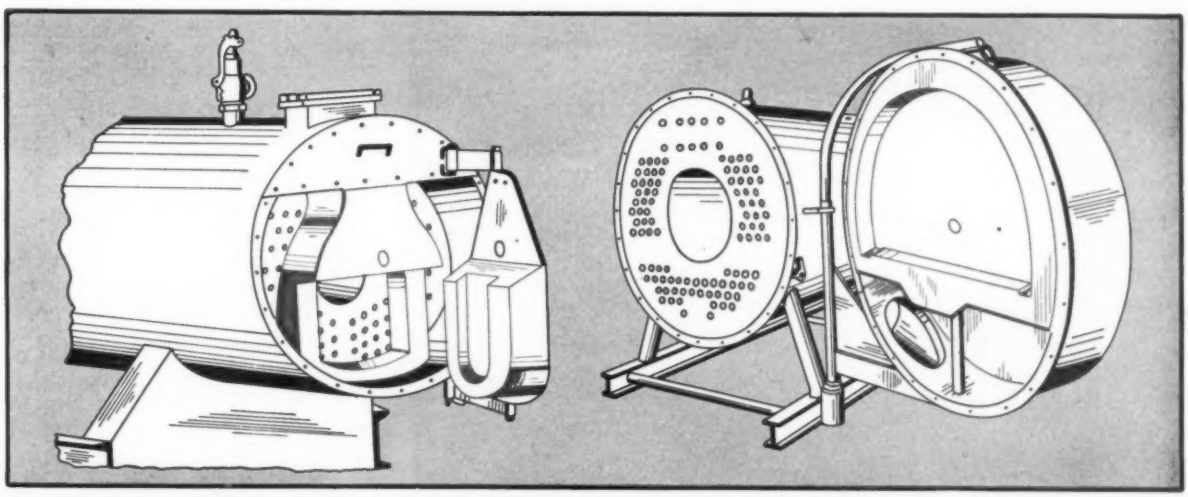
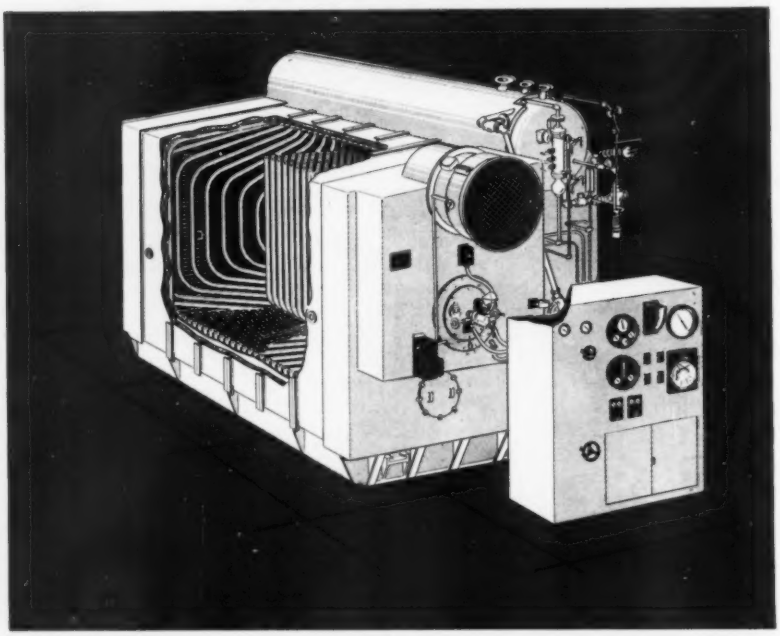


Fig. 9—Boiler components and auxiliaries are mounted to meet demands of boiler inspectors and code authorities. Boilers themselves are easily accessible for inspection and servicing, both inside and out. Auxiliaries and working parts are mounted in plain view on the boiler or supporting frame. Typical of this policy are the hinged-back designs shown here; the entire rear chambers swing back from the rear tube sheet so that the refractory, tube sheet and tubes can be cleaned and inspected with ease. Hinges for the rear cover plate are either attached to the boiler proper, as shown at the left, or by tying into the supporting framework of the packaged boiler base, right. Another method of mounting the cover plate for the rear chamber is to bolt it into place on the boiler frame. Either method will prove satisfactory if sealed

WATER-TUBE PACKAGED BOILERS

SELF-CONTAINED packaged boilers of water-tube design are also shop-erected steam generators that can be shipped completely assembled to plant sites where installation work is confined, for the most part, to making the necessary connections to steam, water and electric service outlets. They are of such size, width, length and height as to meet common-carrier (rail-truck-water) specifications on weight and clearances. Being self-contained, they can be moved at any time after they have been placed in operation.

Illustrations of water-tube boilers, showing furnace construction and giving nomenclature of boiler parts and auxiliaries, are shown in Figs. 10 and 11. They are built with operating pressures from 250 to 900 psi, and with steam-generating capacities up to 35,000 lb per hr. Water-tube units designed for 250 psi can, of course, be operated at pressures down to 15 psi. Typical sizes and capacities of high-pressure boilers are listed in Table 4.



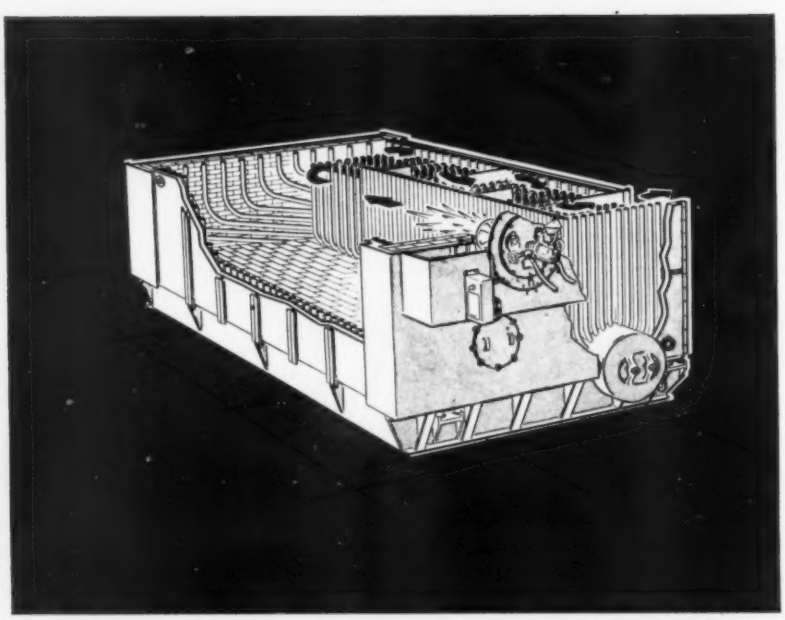


Fig. 10—Water-tube self-contained steam generators are also completely assembled at the factory including auxiliaries and the automatic and safety controls. Most are equipped for oil, gas, or combination gas-oil firing

Basic components of the packaged water-tube unit include the boiler proper, boiler trim, interlocked electronic combustion and safety controls, burner, fan, valves, refractory lining and insulation. They may include boiler auxiliaries such as feedwater pump, condensate return pump, and steam or electric oil pre-heaters for use when burning Nos. 5 and 6 oils. Most types are equipped with lance openings for gas firing, and soot blowers for oil firing. However, internal supports required for soot blowers are usually standard equipment. Soot blowers may therefore be installed at the factory before shipment, or installed later at the boiler site without dismantling any portion of the boiler.

Design of the water-tube self-contained boiler often permits incorporation of superheaters and, for larger sizes, economizers or air heaters, and stokers. Oil and gas fired units require only simple foundations for mounting.

Combustion Control

As with fire-tube steam generators, combustion control for oil or gas fired water-tube boilers can be fully-automatic or semi-automatic. Fully-automatic control provides automatic ignition, high-low or modulating regulation of firing rate, and safety protection against flame failure and override steam pressure. Semi-automatic controls provide all the essentials of fully-automatic operation with the exception of automatic ignition. For the most part, burners used with water-tube packaged generators are equipped with forced-draft air registers. Firing may be by oil, gas or combination oil and gas. Changeover from one fuel to another is easily made, so that advantage can be taken of the more favorably priced fuel.

The boilers are simple to operate with push-button start and stop, and automatic control for handling variations in load. All controls are mounted on an enclosed cabinet usually adjacent either to the front face of the boiler, or directly on the boiler, and within easy reach of an attendant standing

in front of each individual boiler unit.

The water-tube units feature simplified water-cooled furnace construction with low-furnace temperatures, generous combustion chambers with low Btu release per cubic feet of furnace volume, steel encased construction, and large-volume drums with manholes at each end, and factory-applied insulation. They are equipped with a pressure-type peep door giving full view of the furnace and flame characteristics, and a brick-lined access door, permitting easy internal inspection.

Only short stacks are required since mechanical draft provides full furnace pressure and velocity of gases to maintain complete combustion. An interesting feature of water-tube designs is that they permit building right-hand and left-hand units: therefore, when two of the boilers are installed, only one stack with simple breeching connections is necessary, resulting in a saving in installation costs.

All the boilers are, of course, built to conform to the ASME code on boiler construction, and National Board of Pressure Vessel Inspectors' rules on inspection and safety. Electrical devices and electric wiring comply with Underwriters' Laboratories and NEMA codes, respectively.

First Developments

Development of the water-tube packaged steam generator goes back to 1940, when two portable water-tube steam generators, with integral separately fired radiant superheaters, were built for use in the oil fields. These units were early prototypes of the "packaged" boilers later used in large numbers during the last war when the demand for a portable steam generator became very great. Some of the specific wartime applications are stipulated on page 77.

As in the case with fire-tube boilers, water-tube steam generators benefited from wartime applications, being proved under conditions far more severe than normally found in commercial and industrial plants. These units today have highest rates of heat transfer from hot gases to the water in the small diameter steam-generating tubes. The rapid flow of heat through the tubes to the small column of water in each tube makes the boilers "fast steamers" and capable of coming on the line quickly, as well as handling sudden load changes. They are used in industry to handle heating loads, combination heating and process-steam loads, and steam loads for power-generating units, the latter being particularly true when multiple boilers are installed in medium or large sized plants.

Manufacturers of water-tube pack-

TABLE 4—TYPICAL CAPACITIES AND SIZES OF WATER-TUBE PACKAGED STEAM GENERATORS

Capacity,* lb per hr	Length,** ft-in.	Furnace depth ft-in.	Number of passes	Furnace volume, cu ft	Heating surface, sq ft	Weight, lb	Stack dia., ‡ in.
10,000	8- 7½	6-9½	2	265	1,213	40,000	26
12,500	10- 4½	8-6½	2	332	1,489	45,000	28
15,000	12- 1½	10-3½	2	399	1,774	50,000	30
17,500	13-10½	12-0½	1	466	2,147	55,000	32
20,000	15- 7½	13-9½	1	533	2,452	60,000	34
22,500	17- 4½	15-6½	1	600	2,758	65,000	36
25,000	19- 1½	17-3½	1	667	3,063	70,000	38
27,500	20-10½	19-0½	1	734	3,369	75,000	40
30,000	22- 7½	20-9½	1	801	3,675	80,000	42

*Boilers for above capacities are available with operating pressures of 250, 500 or 900 psi. Units designed for 250 psi can be operated at pressures down to 15 psi.
**For all sizes: width = 11 ft, height = 12 ft, steam-drum diameter = 36 in., water-drum diameter = 24 in.
‡ Recommended stack height for listed diameters is 30 ft.

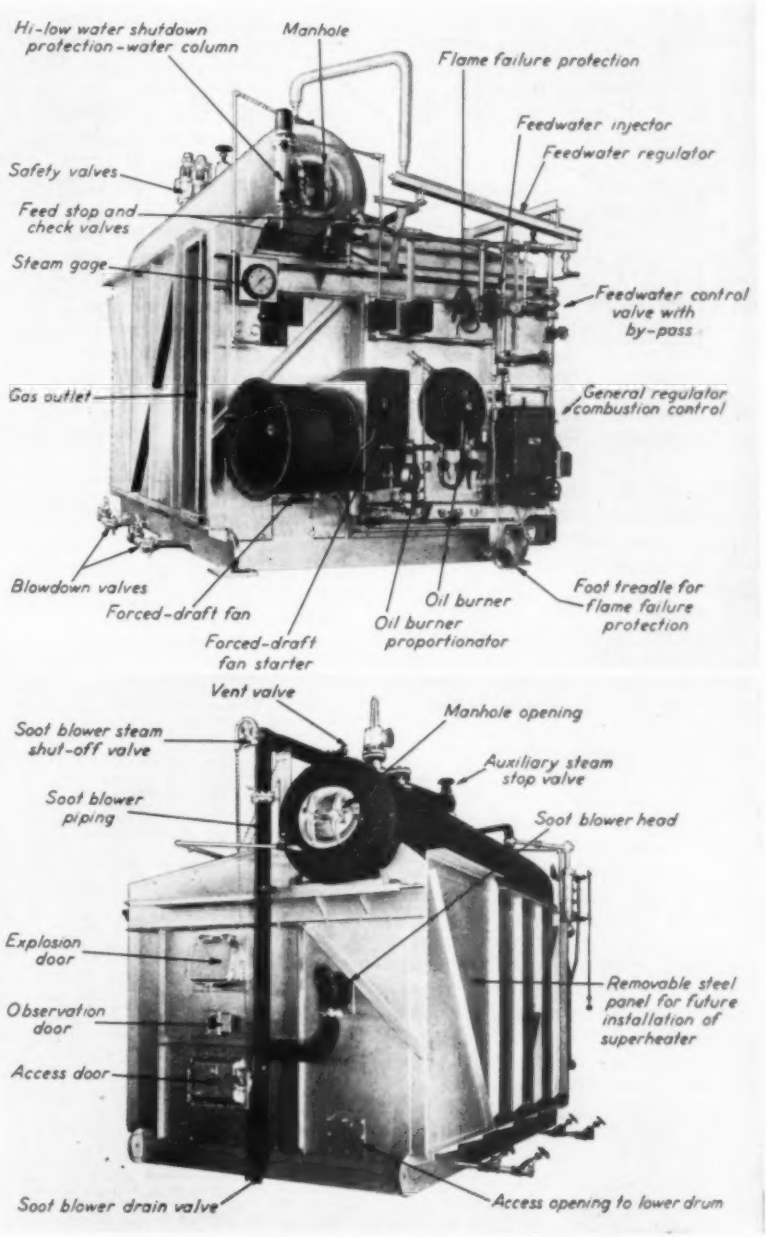


Fig. 11—Nomenclature for water-tube packaged boilers. Design pressures run to 900 psig, and evaporating capacities up to 35,000 lb of steam per hr. Some designs include soot blowers, superheaters, economizers and air heaters

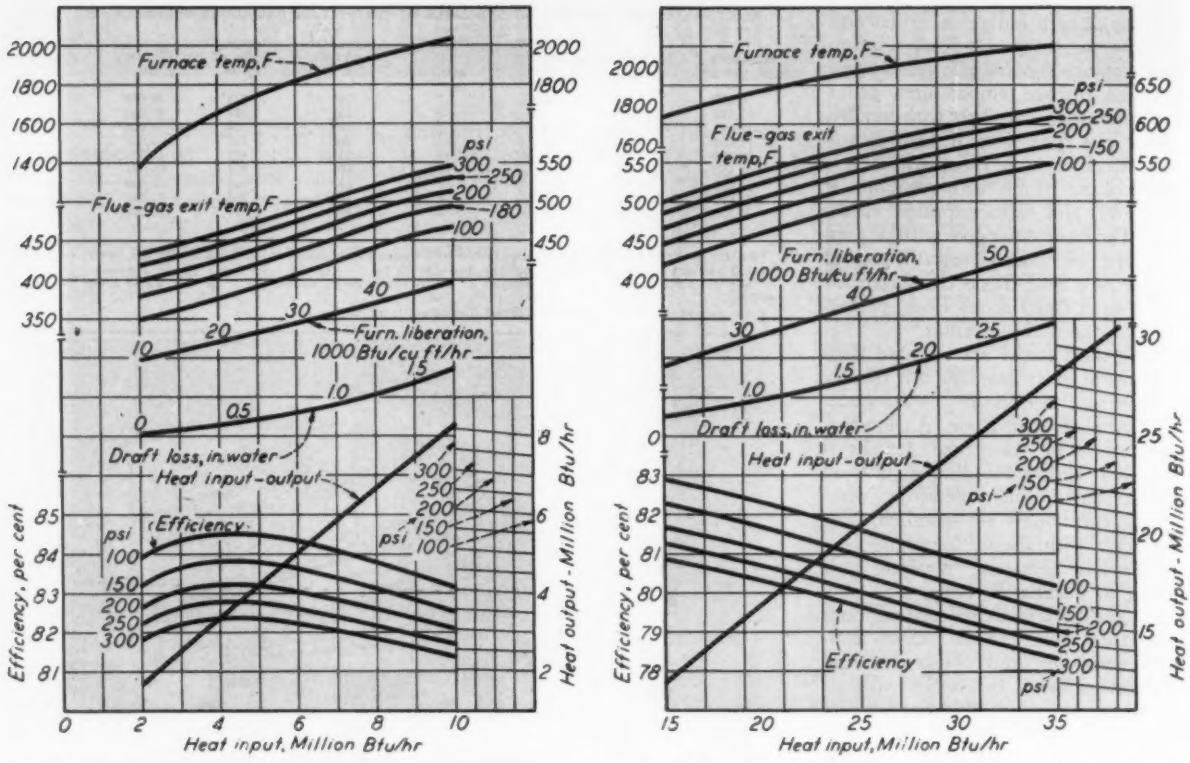


Fig. 12—Performance curves for representative water-tube packaged boilers. Curves at left are for a small-capacity unit firing light oil; those at right for large-capacity unit firing No. 6 oil. Performance data on another boiler are in Table 5

aged boilers rate their units on the maximum amount of steam that the boiler will generate. However, some builders specify nominal ratings in boiler horsepower based on either 10 sq ft of heating surface per hp, or equivalent evaporation of 34.5 lb of steam per hour from and at 212 F—boilers based on these units are frequently operated up to 275 per cent nominal rating.

Performance curves for representative types of packaged water-tube boilers are shown in Fig. 12. Results of four tests on a water-tube packaged unit are shown in Table 5.

Test results in this table show that the unit maintained an over-all efficiency of approximately 78 per cent at all loads between approximately 45 per cent and 100 per cent of rated maximum steaming capacity. Other tests have consistently given efficiencies from 80 to 82 per cent. Throughout the tests the fuel-burning equipment produced a clean fire, a low excess air requirement, a high CO_2 output, and a clear stack exhaust.

The final test of 1-hr duration showed that the unit was capable of operation at approximately 20 per cent over the rated maximum steaming capacity although the over-all efficiency decreased to approximately 75 per cent. Priming was evident as shown by an increased moisture content of the steam.

TABLE 5—PERFORMANCE AND HEAT BALANCE OF WATER-TUBE PACKAGED BOILER

Test number	1	2	3	4
Length of test, hr	4	4	4	1
Boiler design pressure, psi	200	200	200	200
Rated capacity, lb per hr from and at 212 F	16,200	16,200	16,200	16,200
Fuel-oil heating value, Btu per gal	142,128	142,128	142,128	142,128
Fuel-oil heating value, Btu per lb	19,129	19,129	19,129	19,129
Test data				
Oil fired, lb per hr	484.6	920.0	1,021.9	1,309.5
Feedwater to boiler, lb per hr	6,752	12,696	14,419	18,112
Moisture drained from dryer, lb per hr	60	110	135	180
Pressure at boiler drum, psi	177	176	178	165
Steam calorimeter, psi	1.5	1.5	1.5	1.5
Atomizing air to burner, psi	55	87	98	105
Temperature of feedwater, F	136	141	148	151
Temperature of steam at calorimeter, F	298	297	297	250
Temperature of air to FD fan (dry bulb), F	68	55	66	70
Temperature of air to FD fan (wet bulb), F	60	52	56	63
Temperature of fuel oil to burner, F	74	68	73	75
Temperature of ambient air (mean), F	70	61	72	76
Temperature of flue gas from boiler, F	485	625	665	740
Moisture in steam, per cent	0.7	0.8	0.8	3.4
Enthalpy of steam, Btu per lb	1,191.5	1,191.0	1,191.0	1,168.0
Enthalpy of feedwater, Btu per lb	103.9	108.9	115.9	118.9
Heat absorbed, Btu per lb of steam	1,087.6	1,082.1	1,075.1	1,049.1
Performance				
Boiler horsepower developed	217	407	460	563
Equivalent evap. from and at 212 F, lb per hr	7,474	14,064	15,860	19,430
Oil fired, lb per hr	484.6	920.1	1,021.9	1,309.5
Equivalent evaporation, lb per lb of oil	15.42	15.28	15.50	14.85
Total heat input, KB per hr	9,270	17,601	19,548	25,049
Total heat absorbed, KB per hr	7,252	13,646	15,389	18,853
Over-all efficiency, per cent	78.2	77.5	78.7	75.3
Heat release rate, Btu per hr per cu ft of furnace volume	15,300	29,000	32,200	41,200
CO_2 content flue gas, per cent	13.8	15.0	15.0	14.8
CO content flue gas, per cent	0	0	0	0
Theoretical combustion air, per cent	113.2	104.7	104.7	106.0
Heat Balance				
Heat absorbed by unit, %	78.2	77.5	78.7	75.3
Heat loss: dry gas, %	8.3	10.5	11.0	12.4
Heat loss: moisture from combustion of H_2, %	7.0	7.4	7.5	7.7
Heat loss: radiation, ABMA std. allowance, %	3.2	1.7	1.5	1.2
Heat loss: moisture in fuel, unburned combustible and carbon monoxide, %	0	0	0	0
Heat loss: unaccounted for (by difference), %	3.3	2.9	1.3	3.4
Total	100.0	100.0	100.0	100.0

NOTE: All tests conducted on same boiler.

SAFETY AND OPERATING CONTROLS

SELF CONTAINED packaged steam generators can be fully automatic or semi-automatic in operation. A unified control panel installed in a totally enclosed cabinet with a hinged door is usually mounted on the boiler frame. Electric circuits incorporating low-water and steam-pressure limit switches are, as a rule, interlocked through a program relay to control automatic ignition, flame-failure safety device, fuel-burner sequences, motor and oil-heater starters, and dampers that regulate the fuel-air ratio. A simplified wiring diagram for a boiler designed to burn light oils is shown in Fig. 13.

Heart of the automatic control system is the program relay shown in box form in the left hand side of the diagram. It includes (1) a load relay which controls motor, primary fuel valve, and interlock relay circuits and (2) a flame relay operated by a photocell or flame rod and acting on the ignition, secondary fuel valve, and interlock and relay circuits. There is also a thermal-type safety-switch which will, at the end of its timing period, lock in open position following flame failure or failure of a lighting attempt. All other safety controls act upon this relay to start or stop the burner as necessary.

Load and flame relays in the program control must be energized to keep the burner operating. Steam-pressure limit control, low-water control, and the "On-Off" switch are in the supply circuit to terminals 1 and 2. Open limit switches as well as power failure cause instantaneous burner shutdown.

Functions of the program relay determine the basic operation of the control circuit and are as follows:

Starting—When the burner switch is closed and the low-water and pressure controls are closed, power is supplied from terminal 3 to the blower motor, primary fuel valve and the ignition circuit. The thermal switch in the relay has also started its timing-out period and will lock out and break the power circuit if ignition does not take place before the end of the period.

Running — When flame is established and the flame detector has sensed its presence, power is supplied from terminal 5 to the interlock relay, de-energizing the ignition circuit and energizing the secondary fuel valve through the delay timer.

Normal Shutdown — When the operating control consisting of temperature or pressure switches, upper left in the diagram, has been satisfied and opens its contacts, the load relay drops out and removes power from terminals 3 and 5, de-energizing the oil valve and blower motor to stop the burner.

Line-Limit Control Shutdown — Opening of the contacts of any line-limit control (low water, pressure of temperature) will break the power supply, de-energizing the program relay and any controls operated by it.

Failure of Burner — Any failure of the flame will be detected by the photoelectric cell and de-energize the flame relay circuit, returning the program relay and its controlled circuits to the starting condition. If the burner does not restart by the end of the safety timing period, the thermal switch will go into lockout position.

Safety Lockout — When the thermal switch contacts open at the end of the safety period (usually 45 sec) they must be manually reclosed. Usually a 2 min. cooling period is required before the switch can be reset.

Component Failure — Some parts of the electronic coupling circuit between the flame sensing device and relay may fail and yet allow the relay to be energized even in the absence of flame. In this case, the thermal switch operates during normal operating control shutdown and prevents re-operation of the load relay.

The low-water control switch has not only the low-limit safety switch mentioned previously but also a float-operated pump switch which starts or stops the boiler feed pump as necessary to maintain correct water level. A manual control switch may be included

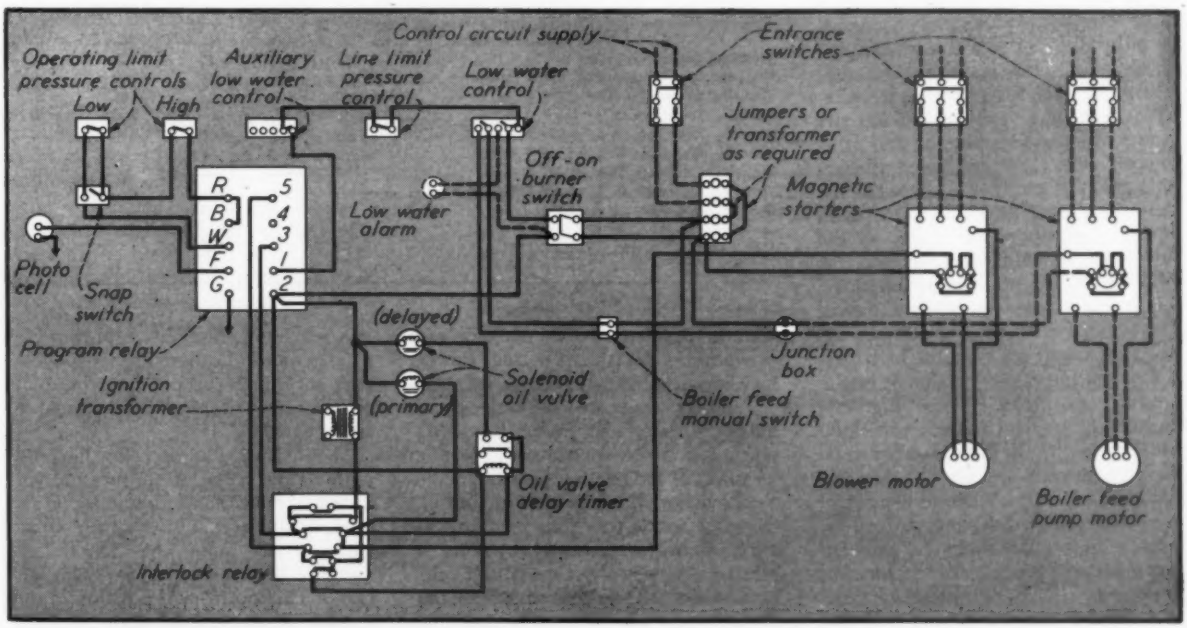


Fig. 13—Wiring diagram for automatic controls on packaged boiler. Circuits incorporate low-water and steam-pressure limit switches interlocked through a program relay to control ignition, fuel-air ratio, flame-failure device, and starter

to allow raising the water level higher than is automatically maintained by the low-water control.

Controls described thus far are basic circuits used on light-oil types of burners. On heavy-oil types more generally employed on the larger boilers, other refinements may be added to insure more certain or stable operation.

Heavier oils require preheating to insure proper atomization in the burner chamber. Generally, initial heating will be obtained from an electrical resistance unit controlled by a magnetic starter with a manually operated "On-Off" switch in series with a thermostat control. An auxiliary steam or hot-water heater may be provided and commonly has designed capacity to heat the maximum quantity of oil consumed at full fire with only 25 per cent rated boiler pressure. When adequate oil temperature is reached and maintained by steam or hot water alone, the electric heater is automatically disconnected by the thermostat control. Another thermostat provided in the control circuit prevents starting the burner until the oil reaches the proper temperature for igniting. This thermostat is shunted from the circuit after the burner is started so that low oil temperature will not cause shutdown.

Burners frequently employ a gas pilot which is ignited during the ignition period. The primary solenoid oil valve shown in the diagram would then be replaced by a gas valve energized in conjunction with the ignition transformer.

On larger boilers, a high-low steam pressure control becomes an added and important feature. It causes the burner to start on low fire and to operate on either high or low fire as required to maintain steam pressure. One type of control uses a steam-pressure actuated, three-wire, two circuit mercury switch which always has one pair of its contacts closed. When boiler pressure falls below a preset value, the switch closes a circuit to the motor of the main blower damper which moves to the full open, or high-fire position. A switch mounted on, and operated by, the damper motor energizes a motorized fuel valve which opens to pass the full flow of oil required for high fire.

On reaching the maximum steam pressure, as preset on the high-low control, the switch changes to the low-fire position, causing the damper to be moved to throttle position. At the same time, the auxiliary switch on the damper motor closes the motorized valve, leaving the primary three-way solenoid fuel open, and the burner is on low-fire operation.

A selector switch is usually provided to permit high- or low-fire or automatic operation. Other auxiliary controls, such as positive low-fire starting and pre-ignition scavenger period timers, may be included when necessary.

Another form of burner control holds the flame intensity in direct proportion to steam demands within preset limits of modulation. Starting from a cold boiler with this type of control, the pilot nozzle functions in the usual manner when the start button is pressed. After a short delay, the solenoid valve on the variable capacity nozzle opens and the burner lights on low fire. Flame intensity increases gradually and automatically to high fire and remains so until steam pressure increases to within the range of modulation for which the pressure control is set. Heating is then proportional to steam demand.

Should the load drop below the minimum of the range, steam pressure will increase above the maximum set on the modulating pressure control, which automatically stops the burner and switches the operation to "On and Off". The control will function in this manner until the load again increases to the point where the modulating control automatically takes over.

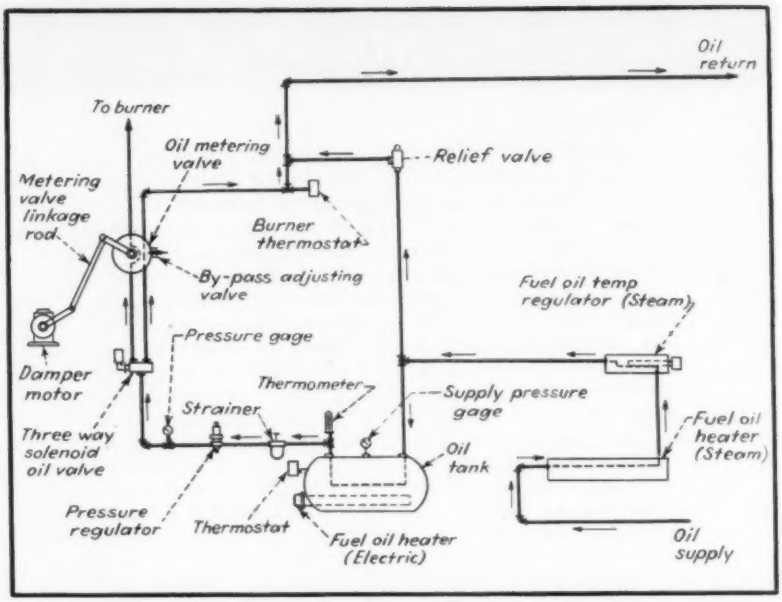


Fig. 14—Diagrammatic sketch of fuel-oil supply system. Oil metering valve and damper motor are operated through program relay to control fuel-air ratio

TABLE 6—CLASSIFICATIONS OF COMMERCIAL GRADE FUEL OILS

No. 1 A distillate oil intended for vaporizing pot-type burners and other burners requiring this grade.
No. 2 A distillate oil for general purpose domestic heating for use in burners not requiring No. 1.
No. 4 An oil for burner installations not equipped with preheating facilities.
No. 5 A residual type oil for burner installations equipped with preheating facilities.
No. 6 An oil for use in burners equipped with preheaters permitting a high viscosity fuel.

Grade of Fuel Oil	No. 1	No. 2	No. 4	No. 5	No. 6
Flash Point, F (Min)	100*	100*	130*	130*	150*
Pour Point, F (Max)	0	20	20	—	—
Water & Sediment, % (Max)	trace	0.10	0.50	1.00	2.00
Carbon Residue on 10% Residuum, % (Max)	0.15	0.35	—	—	—
Ash, % (Max)	—	—	0.10	0.10	—
Distillation Temperature, F — 10% Point (Max)	420	—	—	—	—
Distillation Temperature, F — 90% Point (Max)	—	675	—	—	—
Distillation Temperature, F — End Point (Max)	625	—	—	—	—
Viscosity, Saybolt Universal at 100 F (Max)	—	40	125	—	—
Viscosity, Saybolt Universal at 100 F (Min)	—	—	45	150	—
Viscosity, Saybolt Furol at 122 F (Max)	—	—	—	40	300
Viscosity, Saybolt Furol at 122 F (Min)	—	—	—	—	45
Viscosity, Kinematic C. S. at 100 F (Max)	2.2	4.3	26.4	—	—
Viscosity, Kinematic C. S. at 100 F (Min)	1.4	—	5.8	32.1	—
Viscosity, Kinematic C. S. at 122 F (Max)	—	—	—	81	638
Viscosity, Kinematic C. S. at 122 F (Min)	—	—	—	—	92
Gravity, deg., API	35	26	—	—	—

* or legal

OIL HANDLING AND FIRING EQUIPMENT

MOST SELF-CONTAINED packaged steam generators are oil fired, because of the widespread availability of this fuel. The burner may have either fully- or semi-automatic ignition, the choice usually depending on the type of fuel used or the size of the boiler to which the burner is applied. Burners employ various types of ignition, including gas-electric, oil-electric or manual; also, they utilize thermostatic stack control or photoelectric-cell instantaneous flame-failure control.

Burners include in their unit assembly or in their system a method of controlling the fuel-air ratio. A diagrammatic sketch of an oil-supply system, including oil and air metering controls, is shown in Fig. 14.

Fuels employed range from No. 3 to No. 6 (bunker C), specifications for which are given in Table 6. Use of heavy oils calls for independent oil-conditioning and oil-handling equipment. Electric oil preheaters are used at the burner, while electric, hot-water or steam heaters are used in the oil-supply lines and storage tanks.

For smooth operation and maximum burner efficiency, close regulation of the temperature of heavy oils and the pressure under which they are fed to the nozzles of the burner is necessary. The most suitable preheating temperature for any given oil is usually determined by trial. For preliminary guidance, the following preheat temperatures may be tried: No. 4 oil—no preheat; No. 5 oil—120 to 160 F; No. 6 oil—130 to 200 F. Performance curves for boilers fired with light oil and heavy oil, averaged from a number of tests on units of 80 to 125 hp, are shown in Fig. 15. Data on fuel consumption are given in Table 7.

Fuel-oil piping layouts vary in design, depending upon the number of boilers in the plant, type of oil fired, average yearly climatic conditions, fuel-oil storage facilities, and location of fuel-oil tank. Fuel-oil storage and piping are designed in accordance with requirements of the National Board of Fire Underwriters, and comply with special State or local requirements. Typical oil-line layouts and arrangement of oil-handling, regulating and control equipment are shown in Figs. 16, 17, 18, 19 and 20.

Storage tanks should be sized correctly, and usually large enough to hold a 10-day supply of fuel. They should be convenient to unloading and pumping equipment, keeping pipe runs as short as practicable. Underground tanks are commonly used because they conserve useful floor space, and tend to prevent excessive cooling of the fuel during cold weather.

Underground tanks should be well protected with red lead paint, prepared asphalt or coal tar, or other proved material. If the ground above the tanks is likely to become flooded, the tanks should be anchored in concrete to prevent their lifting by reason of their buoyancy. Underground tanks should be below the frost line. A minimum of 24-in. ground cover is the recommendation generally given.

The fuel-pump suction line between tank and pump should be equipped with a check valve just above the tank. The ability to remove the valve quickly for inspection or cleaning is highly important.

If the suction line is long, or there is a high suction lift, it is usually advisable to install a plugged T in the suction line close to the pump so that the entire line back of the check valve may be filled with fuel oil in order to start the system working quickly.

A strainer must be installed in the suction line just ahead of the fuel oil

TABLE 7—TYPICAL ELECTRICAL AND FUEL CONSUMPTION DATA

Boiler hp	Pressure atomizing burner, Motor hp Fan	Horizontal rotary burner, Motor hp Fan	Horizontal rotary burner, Motor hp Burner	Electric immersion heater, No. 6 oil only kw	Gallons oil per hour at rating: No. 6 oil Approx. 152400 Btu/gal	No. 5 oil Approx. 148800 Btu/gal	Light oil Approx. 140000 Btu/gal
20	1	¾	¾	1*	5.50	5.62	6.00
30	1½	¾	¾	1*	8.25	8.43	9.00
40	2	¾	¾	1*	11.00	11.24	12.00
50	2	1	¾	1*	13.75	14.05	15.00
60	3	1½	¾	1*	16.50	16.86	18.00
70	3	1½	¾	2	19.25	19.67	21.00
80	3	1½	¾	2	22.00	22.48	24.00
100	Note A	2	¾	2	27.50	28.10	Note B
125	Note A	3	1½	2	34.57	35.13	Note B
150	Note A	3	1½	2	41.25	42.15	Note B
200	Note A	5	2	3	55.00	56.20	Note B
250	Note A	5	3	4	68.75	70.26	Note B
300	Note A	7½	3	4	82.50	84.30	Note B
350	Note A	7½	5	5	96.25	98.35	Note B
400	Note A	7½	5	5	110.00	112.40	Note B
450	Note A	10	5	5	123.75	126.45	Note B
500	Note A	10	5	5	137.50	140.50	Note B

*110 v—2 kw for 220 v
Note A—Usually furnished with horizontal rotary burner
Note B—Rarely used above 80 hp

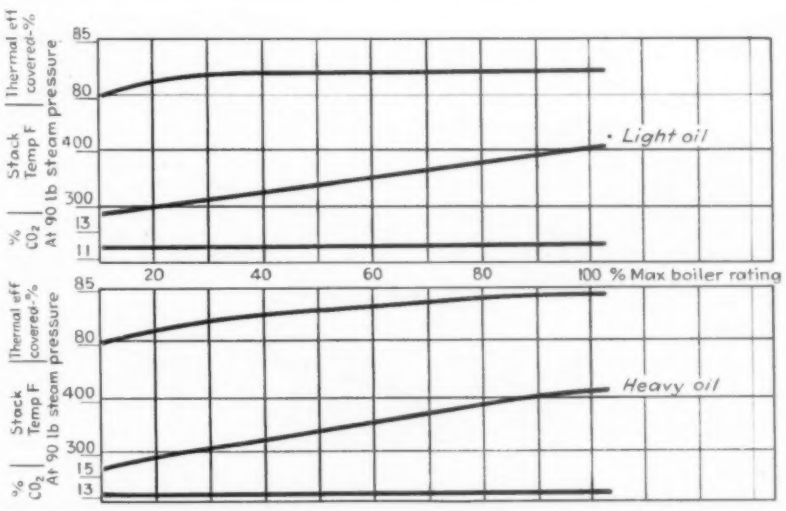


Fig. 15—Comparative performance curves for self-contained boilers fired with light and heavy fuel oils. Data are from tests on units of 80 to 125 hp

TABLE 8—RECOMMENDED SIZES OF FUEL-OIL PIPE LINES

Boiler rating, hp	Grade of oil	Length of oil line, ft	Line sizes, in. Suction	Return	Double tapped bushings, in.
10 to 60	To No. 3	10 to 150	¾	¾	2 x ¾
70 to 80	To No. 3	10 to 150	1¼	1¼	3 x 1¼
40 to 150	Nos. 4 & 5	10 to 90	1½	1½	3 x 1½
40 to 150	Nos. 4 & 5	100 to 150	2	2	3 x 2
200 to 500	Nos. 4 & 5	10 to 90	2	2	3 x 2
200 to 500	Nos. 4 & 5	100 to 150	2½	2½	4 x 2½
40 to 300	No. 6	10 to 90	2	2	3 x 2
40 to 300	No. 6	100 to 150	2½	2½	4 x 2½
350 to 500	No. 6	10 to 90	2½	2½	4 x 2½
350 to 500	No. 6	100 to 150	3	3	4 x 3

NOTES: Keep suction lines as short as possible, and run them with a minimum of turns and bends. Copper tubing is usually recommended for No. 3 and lighter oils, standard steel or wrought iron pipe for Nos. 5 and 6 oils. The use of extra-heavy couplings and ground-joint unions are also recommended. All piping should be absolutely tight to insure against leaks. During installation, be sure pipe threads are clean cut; open ends of oil lines should be suitably plugged or capped to prevent entrance of foreign matter.

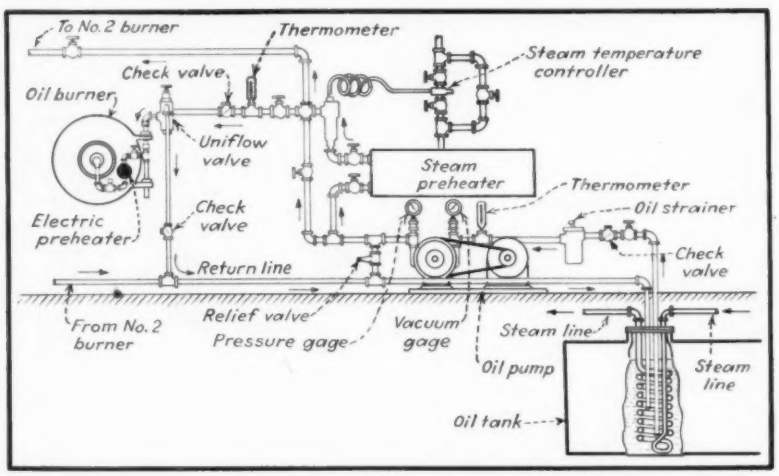


Fig. 16—For smooth operation and maximum burner efficiency, close regulation of temperature of heavy oils is required. Electric oil preheaters are used at the burners, while electric, hot-water or steam preheaters are employed in the oil lines. Storage tanks usually have steam or hot-water preheaters

pump to prevent foreign matter from entering and injuring the pump.

The size of all piping runs for fuel oil is very important. Heavy oil will increase considerably in viscosity at low temperatures, causing an increase in hydraulic (pipeline) friction and pressure drop. For average installations, typical pipe diameters for suction and return lines are given in Table 8.

It is good practice to install a number of plugged T's in the oil-line to provide openings for sampling fuel oil, priming the lines, or for extra gages and thermometers. Only gate valves should be installed in the oil pipes.

Oil lines should be checked for tightness. This can be done by applying a 50-psi air-pressure or 100-psi hydrostatic test, after sealing all openings in each section of the line to be tested, and installing a pressure gage. The line should show no measurable pressure drop after standing under pressure from 15 to 45 min.

A loop system for supplying oil to two or more boilers in one location is sometimes less costly to install than separate suction lines. One such system is shown in Fig. 21. The loop system is also advantageous in the following cases: (1) where the boiler or boilers are shut down over weekends or for sufficient length of time to permit oil lines and storage tank to cool off; (2) where the oil lift from the bottom of the tank to the oil pump or burner is more than 12½ ft; (3) where two or more tanks are required and where it would be an advantage to be able to pump from one tank to another; (4) where boilers are located more than 150 ft from the storage tank or tanks; and (5) where storage is buried in wet ground, and requires constant heat supply to keep oil at a temperature that will permit efficient pumping.

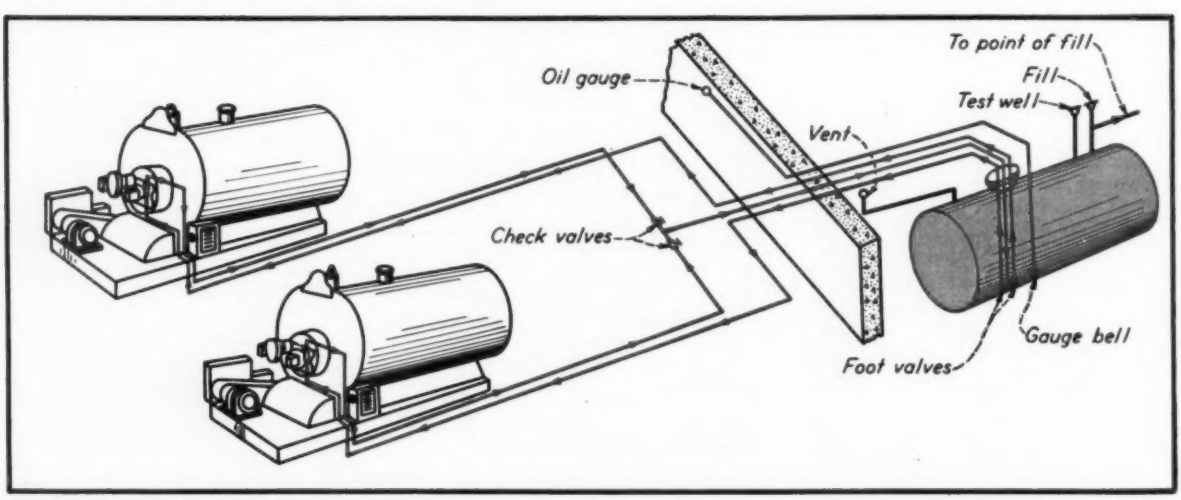


Fig. 17—Typical light-oil supply line from single storage tank to two boilers. Each unit has separate suction line, while return lines from the boilers meet in common return line to the tank. Check valves keep oil flowing only to the storage tank

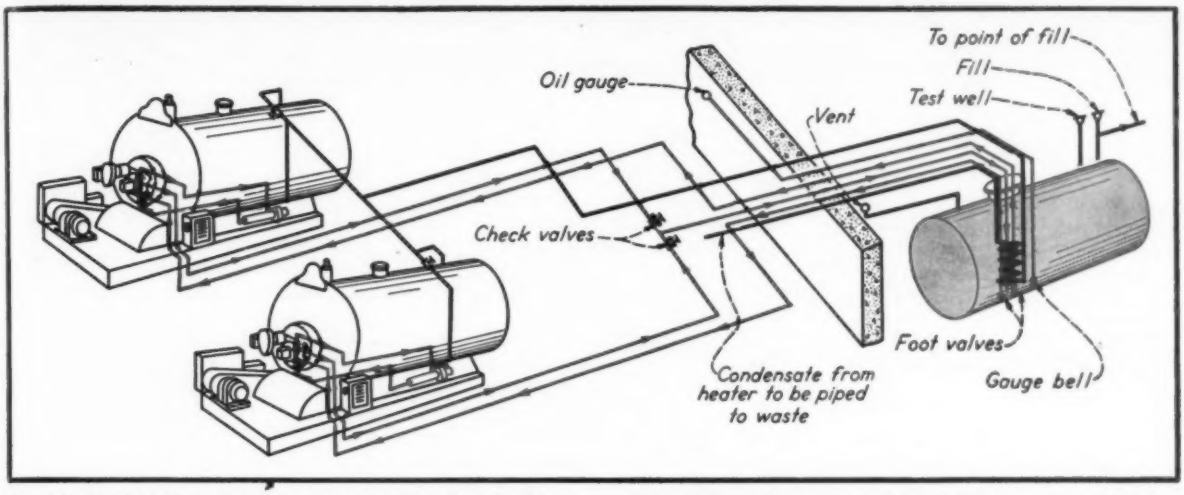


Fig. 18—Method of piping two units to a single oil tank where heating coil is used in the tank. Each boiler has separate suction line and common return with check valves. Return line is placed so warm oil returns between suction stubs

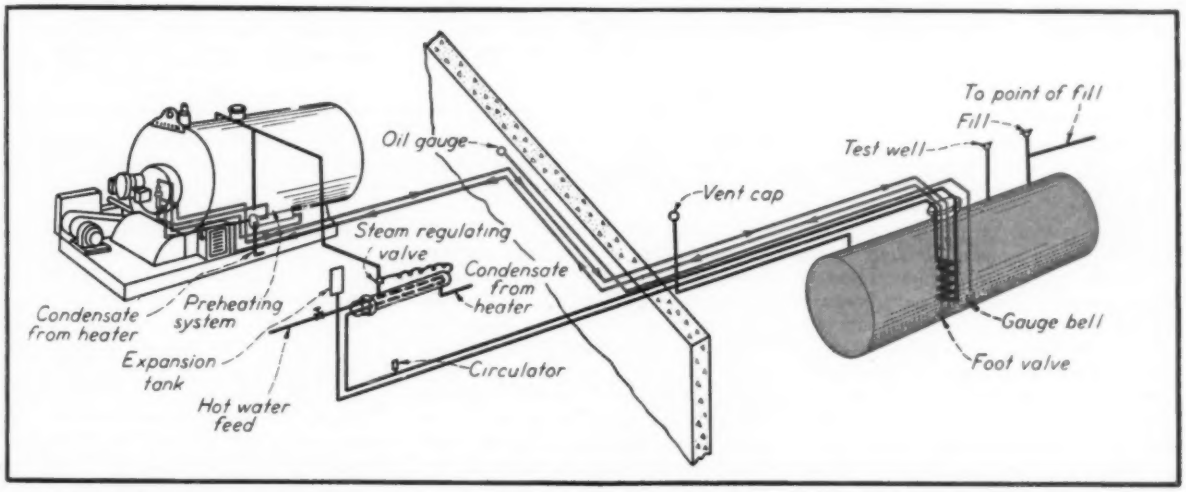


Fig. 19—With low-pressure boilers, hot-water system can be used instead of steam for heating oil in storage tank. It is employed because there may not be enough steam pressure to push condensate through coils, which would become clogged

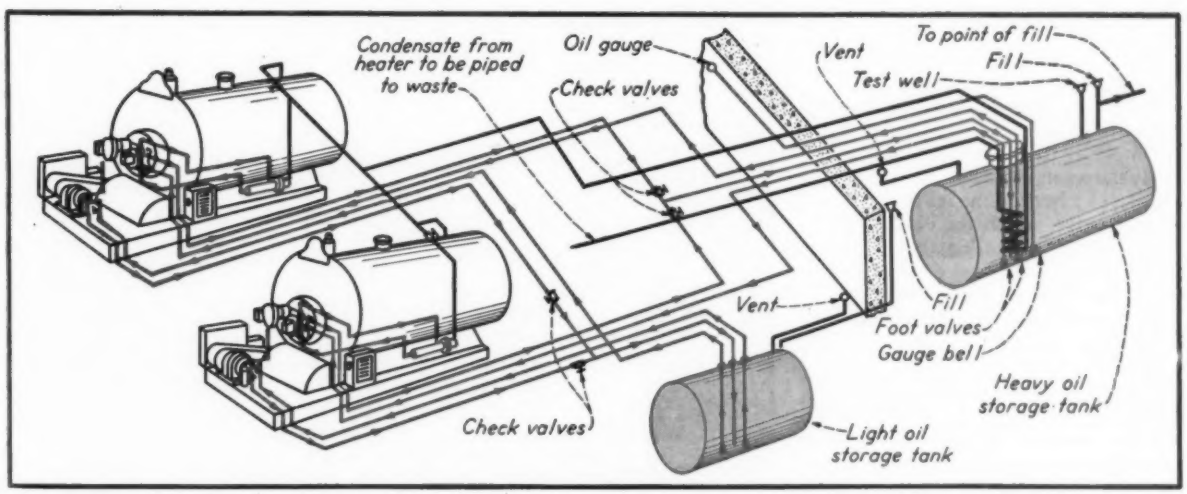


Fig. 20—This type of oil-line system is used in two instances: (1) for starting on light oil until steam is available to heat oil in main storage tank, and (2) where gas is not available for ignition, necessitating use of light oil

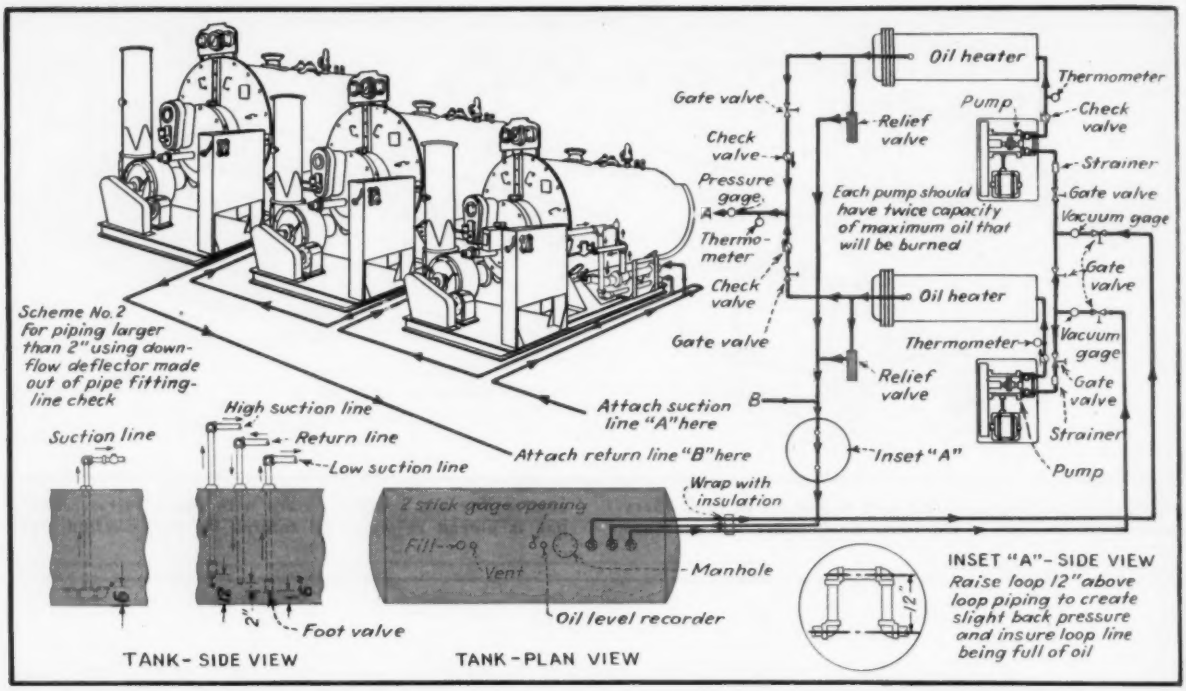


Fig. 21—A loop system of this type can be used for supplying oil to two or more boilers in one location. High temperature return oil, use of high suction lift, and pumping from one storage tank to the other are among advantages

A loop system consists of a single or duplex pump generally located near the fuel-oil storage with a fuel-oil heater connected to the pump's discharge. The oil discharged from the pump is piped to the boiler location and then returned to the oil storage in one continuous loop from foot valve to return pipe in the tank. The oil pumps on the burners at the boilers have their suction and return lines connected to this loop by Y fittings faced in the direction of oil flow. The oil pumps should each have a capacity of double the amount of oil that will be burned at maximum firing so that a sufficient amount of heated oil will be returned to the storage tank to keep oil in the tank at pumpable temperature.

Fuel oil preheaters should be cleaned regularly to prevent excessive fouling.

Unusually bad carbonization is generally the result of one of the following causes: (1) heating the oil beyond the normal range, which for No. 6 oil is 225 to 275 F; (2) coking of oil upon the heating surfaces caused by stoppage of oil flow through the heater but continued steam flow; (3) the oil may be other than usual grade, more readily carbonized.

When it is necessary to clean fuel oil heaters wherein the steam flows through centrally located tubes while the oil flows through the space between the tubes and the shell, the arrangement shown in Fig. 22 can usually be employed with satisfactory results.

After the piping has been arranged as shown, valves *A*, *C* and *E* are closed, and valves *B* and *D* opened. The heater is then pumped full of a cleaning emulsion, one of which consists of one part Oakite No. 7 and four parts kerosene. After the heater is full, the pump is stopped and valve *B* closed. The emulsion should be left in the heater for 24 to 48 hr, and then drained into a receiver via the drum and valve *F*.

The drum can then be filled with a cleaning solution. With valves *D* and *F* closed, and valves *B*, *C* and *E* open, the cleaning solution should be circulated through the heater for about 24 hr, keeping the solution at about 200 F by a regulated steam flow through the heater. Afterwards, with left-hand valve *A* open and all other valves closed, the heater can be blown out thoroughly with steam or air. With the heater cleaned, the piping can be reconnected for normal operation.

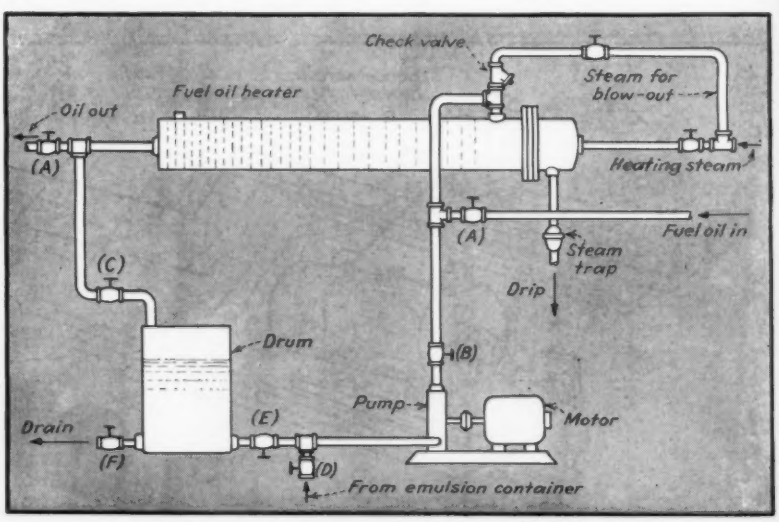
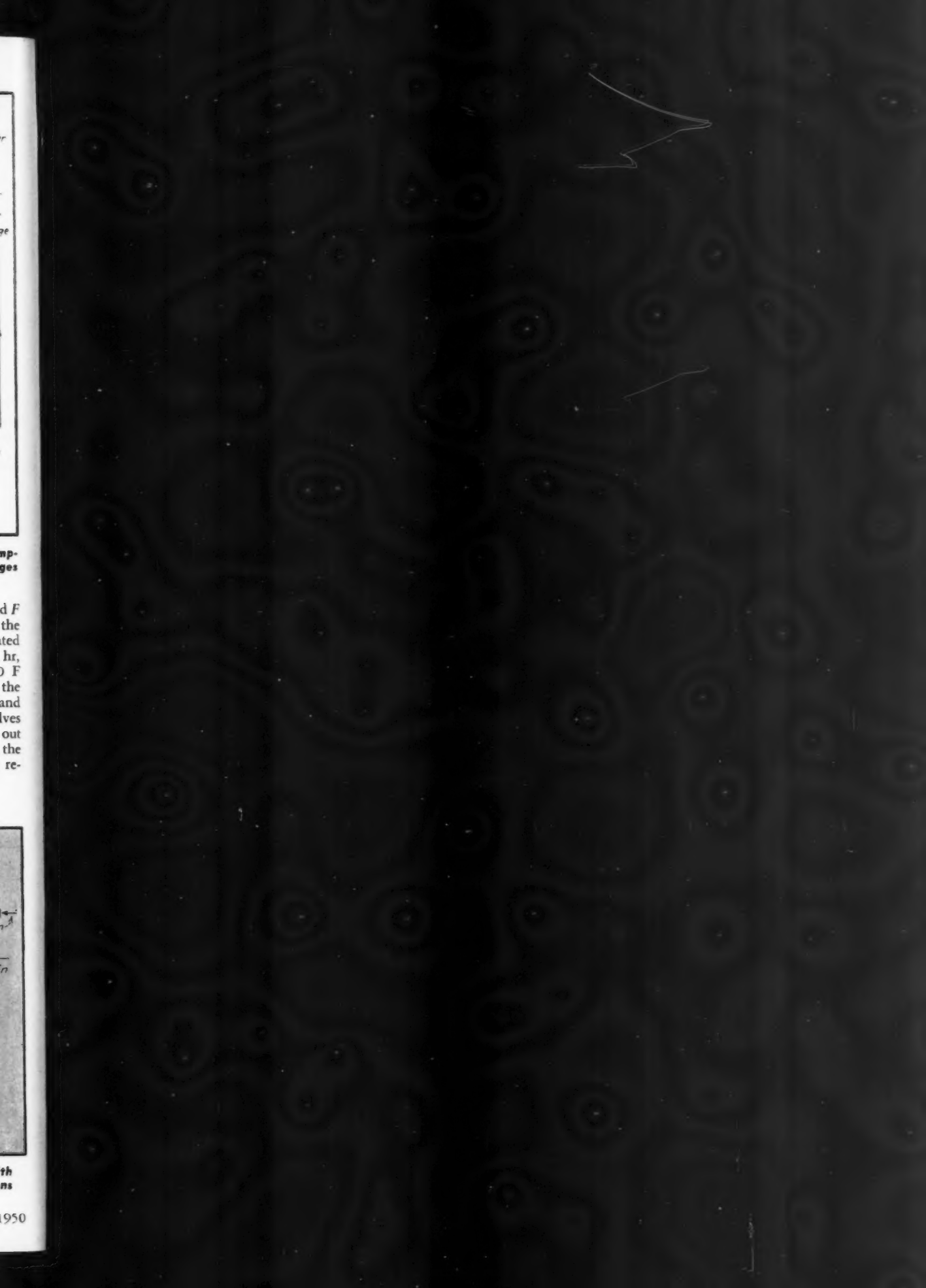


Fig. 22—When it becomes necessary to clean fuel-oil preheaters clogged with carbon, piping can be re-arranged as shown here to facilitate operations



OPERATION AND MAINTENANCE

OPERATION of the modern self-contained packaged steam generator involves no new principles governing reasonable care. But it is necessary to stress continuously those fundamentals of good operation which include periodic inspection, preventive maintenance, and correct procedures for heating and treating feedwater and for proper blowdown.

Each boiler manufacturer provides specific instructions for starting up new boilers, as well as for starting up repaired units and those that have been off the line but a short time. Particular stress is placed on proper operation and maintenance of oil-handling and firing equipment; also, on correct procedure for checking and operating automatic electric control and safety equipment. Suggestions for starting up new boilers are given below.

Feedwater Treatment

Feedwater treatment and blowdown are inherently the same with all types of boiler installations, and are, of course, related to the amount of raw makeup water and its characteristics.

Feedwater treatment for self-contained packaged boilers is today receiving considerable attention from firms specializing in feedwater materials and equipment. One company recently announced a service contract plan for packaged-boiler plants, which essentially provides the same water treatment as used today in many of the nation's largest power plants. This service is designed to offer the protection and security of a complete water-treatment program to the operators of packaged boilers, the chemical requirements for which would normally be too small to warrant the service attention necessary to establish and operate such a complete system.

It is necessary that the feedwater be properly treated to prevent deposits of scale and sludge, and prevent internal corrosion, as well as to avoid so-called caustic embrittlement cracking. Any treatment should be based on an analysis of the water and should be checked frequently.

Blowdown

Frequency and quantity of boiler blowdown go hand in hand with feedwater treatment, and such specifications are usually supplied by specialists who prescribe feedwater treatment. In the absence of other definite instructions, it is usually recommended that the boiler, water column, and low-water controls be blown down at least once a day. Blowdown should occur at a period

SUGGESTIONS FOR STARTING-UP NEW BOILERS

1. Check air inlets to the boiler room. Openings must be provided to admit sufficient air for combustion. Usual recommendation is openings of 2 sq ft per 100 hp of the boiler.

2. Do not insulate boiler shell until after the boiler has been put into final operation.

3. Check the installation thoroughly to be sure all necessary piping and wiring connections have been made and tested.

4. Be sure a proper supply of fuel is available for continuous operation. When the boiler is designed for burning heavy oils, a lighter oil is often recommended for start-up.

5. Close all unused connections in the boiler shell. Use of extra-heavy nipples and caps is recommended in lieu of solid plugs to provide access to connections after boiler is insulated.

6. Lubricate all motors and bearings.

7. Check rotation of all motors.

8. Open water-column shut-off valves, gage-glass shut-off valves, steam-pressure gage valves, and vent valves.

9. Close blow-off valves, and fill the boiler to middle of the gage glass. Drain about one gallon of water from blowdown valves of the water column and the low-water cut-off devices.

10. Set burner controls, low-water cut-off controls, pressure controls, and feedwater controls.

11. Make certain that the setting of the line-limit pressure control is lower than the relief setting of the safety valves.

12. Check electric circuits to see that proper sequences occur in the operating and safety control equipment.

13. Test and adjust automatic ignition equipment.

14. Test and adjust burner and its controls.

15. With preliminary adjustments made, the boiler water at correct level, and fuel available at the burner, the burner is ready to light.

16. Before attempting to fire the burner or make adjustments, test electric circuits and operation of the entire burner control and ignition system thoroughly.

17. After the flame has been established, adjust low fire to allow stable combustion without producing excessive smoke at the vent.

18. Check firing rate. Use small fire to warm up the boiler gradually to prevent damaging refractories and the boiler proper.

19. Check all pipe connections and gasketed joints for leaks, and if necessary tighten while boiler pressure is rising.

20. Maintain normal water level in the gage glass throughout the firing-up period.

21. While the boiler is being brought up to pressure, check the water column and gage glass. Blowdown both, and be sure that water returns to proper level promptly.

22. Check all automatic operating and safety controls.

23. Retighten nuts on the front and rear boiler-head studs of boilers as they are brought up to normal operating temperature.

24. Repair any flue gas leaks that develop at gasketed joints.

25. Make final burner adjustments with the aid of flue-gas analysis. A CO_2 reading of between 12 and 13.5 per cent at high fire is desirable for good combustion.

26. In lieu of flue gas analysis for making final burner adjustments, proper setting of burner control valves can be made by opening the valves until smoke appears in the stack, and then closing them just enough to eliminate the smoke. Adjustments in combustion control equipment may be necessary to suit later changes in oil temperature or oil pressure to the burner.

27. Safety valves should be checked as soon as possible by lifting off seats with a hand lever, or raising pressure to pop-off point. Rules for boiler care suggested by ASME call for hand-testing safety valves and holding them open for a short period to blow out any dirt.

28. When the boiler is fired and put into service for the first time, condensation may accumulate and run out of the front end and rear flue passes of the boiler. Such accumulation is due to products of combustion and moisture from refractories. Usually, front end and rear flue extensions are equipped with drain openings to remove condensation. After high-fire operation has been established, such drainage should cease. Pipe plugs should then be screwed into the drain openings.

Additional Checks for Oil-Fired Units

A—Open all oil valves in the oil suction and return lines.

B—Start oil pump and allow oil to fill the electric-heater tank and oil lines to the burner.

C—Set the heater to recommended temperature. Turn on heater.

D—Set fuel-oil relief valve in the oil suction line.

E—With heavy grades of oil requiring high pre-heating temperatures, electric heaters can supply only a limited quantity of preheated oil; consequently, if the burner is turned over to high-fire operation before heating assistance is obtained from steam or hot-water fuel heaters, the oil temperature will drop and atomization of oil by the burner will be reduced. Flame-failure or unstable combustion will result.

when the steam requirement is light. Water in the boiler should never be blown down below the bottom of the gage glass if the boiler and the refractories are hot; hot refractories will impart heat to the boiler, which may cause leaks and tube-sheet damage.

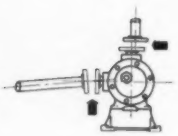
Water Level—Packaged boilers are equipped with automatic means for maintaining boiler water level. The "on-and-off" position should be checked regularly so that this control maintains the proper water level. The units are also equipped with low-water cut-off devices to prevent operation of the fuel burner if the water level drops beyond its low setting. Water should still be visible in the gage glass when low-water cut-off cuts off the burner.

Safety Valve Setting — Safety valves should be checked periodically to see that they conform to the proper setting. The pressure shown on the steam gage should be equal to the pressure at which the safety valve is supposed to blow.

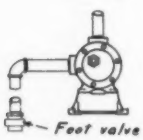
Condensate Return — Whenever possible, the water evaporated by the unit should be returned to the boiler as condensate, providing no oil, scale or sediment is present in the condensate. Means should be provided for heating make-up water to 180 F. The boiler feed or condensate pump should be connected to the boiler with two checks for proper sealing. If a hand-operated shut off valve is also used, a pressure-relief valve should be installed between the hand shut off valve and the

INSTALLATION AND MAINTENANCE OF OIL PUMPS

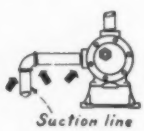
MOUNTING—Place the pump in position, making sure the base is not sprung. An uneven surface may cause binding, stuffing box or pedestal bearing heating, and premature wear of pump parts.



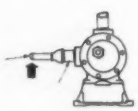
PORT CONNECTIONS—After the suction and discharge connections are made the shaft should turn easily by hand. If this is not possible the pump has been sprung. Check the foundation bolts and pipe connections to relieve the tension.



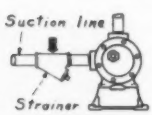
SUCTION LINES—Place pump as close to the source of supply as convenient. On long suction lines a foot or check valve is recommended. Do not install a pipe smaller than the pump suction port. This will cause a decrease in capacity.



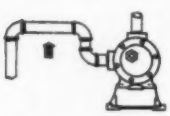
PIPE CONNECTIONS — All pipe line connections must be tight. Use shellac, glycerine-litharge or some other good compound in making up pipe joints. An air leak causes pump noise; decreases pump capacity; and reduces pressure.



SIZE OF PIPE—Pipes must equal or be larger than pump ports. Next larger size is preferable for heavy oils or suction lines over 100 ft. Suction lift from underground tank should not be over 10 ft.



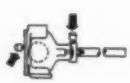
STRAINERS—Strainers should be installed in all suction lines to prevent foreign matter entering pump. They must be large enough to prevent restricted flow, which increases power consumption.



HIGH SPOTS IN LINE—Suction and discharge line high spots should be avoided if possible; they produce air pockets, causing unsatisfactory operation. If unavoidable, install air cocks at high point.

RELIEF VALVES—Pumps displace equal amounts per revolution. If at any time the discharge line is to be shut off and pumping continues, a pressure relief valve should be installed as a protection against high head pressure and overload.

PACKING GLANDS—Do not turn packing gland nuts up too tightly. This may cause the packing to bind on the pump shaft, making the bearings run hot or throwing an overload on the motor.

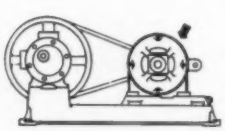


LUBRICATION—Keep pump lubricated at all times, using best grade of grease obtainable for service. Consult your oil supply house for recommendations. Grease is cheaper than repairs.

DISCHARGE LINES — The discharge line should be installed air tight to prevent any line-pressure loss. By eliminating as many sharp turns and elbows as possible friction head will be reduced, requiring less power. When changing to smaller pipe than the discharge port, install a streamline reducer.

HEAD GASKETS—Replaced gaskets should be the same thickness as originally furnished. If not, end play and slippage will lower capacity, pressure and operating efficiency.

PUMP SPEED FOR HEAVY LOAD—When handling heavy liquid loads reduce pump speed. The reduction varies according to the liquid's viscosity.



POWER—Select motor or engine for greater capacity; Too much is far better than too little. Provide for future expansion or changes. Temperature must also be considered where the viscosity of liquid is affected by hot or cold areas during transfer.

MAINTENANCE HINTS

NOISY OPERATION — Supply is insufficient, causing operation against a pa tial vacuum. High spots in line allowing air to pocket. Pump out of alignment, operating too fast or against high pressure.

LOSS OF SUCTION—Suction line not immersed. Supply exhausted. Leak in line. Inlet closed or too near tank bottom. Pump worn. Suction lift too high. Liquids vaporizing or breaking at suction lift.

RAPID WEAR—Grit or dirt in liquid handled. Install a strainer or arrange to filter the liquid. Pipe strain on pump casing causing working parts to bind. Pump operating against an excessive pressure.

DECREASED CAPACITY—Liquid supply insufficient or varies in viscosity. Low voltage reducing motor speed. Excessive suction lift. Liquid handled vaporizes under vacuum. Leak in suction line. Pump worn out resulting reduction of the suction and head pressure.

OIL PUMP OPERATION—Failure of pump to operate or deliver sufficient oil may be due to the following reasons: air leaks or air traps in suction line; oil strainer clogged; suction line too small; pump rotating in wrong direction; three phase motor operating on single phase because of fuse failure; and low voltage applied to the motor so it will operate below rated speed decreasing capacity.

SERVICE HINTS FOR ROTARY OIL BURNERS

Fire Puffs On Start

1. Starting draft poor.
2. Lean fire.
3. Insufficient gas pilot.
4. Water in oil.
5. Oil too cold.

Fire Goes Out While Burner Running

1. Out of oil.
2. Strainer dirty or clogged.
3. Clogged metering valve.
4. Clogged piping or foot valve.
5. Water in oil.
6. Leaky suction line.
7. Low fire set too low.
8. Magnetic oil valve burned out.
9. Oil too cold.
10. Fire burns away from nozzle.

Improper Combustion

1. Fire puffs or fluctuates:
   (a) Fire burning away from nozzle (nozzle or cup not located properly).
   (b) Poor draft.
   (c) Excessive oil temperature.
   (d) Water in oil.
   (e) Unsteady oil pressure.
2. Carbon in combustion chamber:
   (a) Wrong shaped fire.
   (b) Insufficient primary air.
   (c) Forcing burner.
   (d) Damaged atomizing cup.
   (e) Nozzle or cup off center.
   (f) Carbonized nozzle.
   (g) Carbonized atomizing cup.
3. Fire smoking:
   (a) Improper burner adjustment.
   (b) Insufficient air or too much oil.
   (c) Carbon in combustion chamber.
   (d) Boiler room starved for air.
   (e) Lean fire burning at low temperature.
   (f) Improper oil temperature.

Burner Starts But Will Not Light

1. Faulty ignition—gas off or low gas pressure. Hot wire igniter has poor circuit. (Tighten all connections.) Spark type igniter not spaced correctly or grounded. Transformer shorted or burned out. Stopped up gas valve.
2. Improper air-oil ratio.
3. Oil supply failed or insufficient.
4. Water in oil.
5. Oil valve switch on motor base in "off" position.

Burner Will Not Start

1. Thermostat, limit controls, or time clock, normally off.
2. Time clock run down or out of cycle.
3. Low water cut-off open.
4. Manual reset safety switch in control relay open.
5. Thermal cut-outs in relay open.
6. Combustion control has not recycled to cold or starting position.
7. High-low operator has not recycled to low fire position.
8. Remote control, panel, or other switches open or fuses blown.
9. Defective relays or contacts.
10. Oil temperature below settings of reservoir or heater thermostats.

Burner Continually Off And On

1. Fluctuating water level tripping low water cut-off.
2. Loose connections or defective control.
3. Controls not connected properly or not properly adjusted.
4. Partial electrical ground.
5. Intermittent low voltage.
6. Combustion control opens circuit when burner goes on low fire.

Burner Starts and Lights But Locks Out

1. Combustion control slow in making contact because of sooted element, element worn out, auxiliary air damper opens too slowly on high-low linkage, fire too lean.
2. Oil supply fails due to leak in suction line or no oil.
3. Insufficient time for ignition.
4. Insufficient time on safety lockout switch.
5. Smothered fire due to too little air.
6. Control contacts broken or dirty.

Main Controls Function But Burner Does Not Start

1. Twist lock plug defective or loose.
2. Motor defective.
3. Motor stalled.
4. Pump frozen or fan improperly placed.
5. Loose connections at motor or terminal box.
6. Motor starter defective or thermal cut-outs open.
7. Belts slip or broken.

Noises

1. Check projection of atomizing cup beyond nozzle.
2. Roaring fire—generally high velocity primary or secondary air.
3. Frying—caused by water in oil striking hot refractories.
4. Rattle—caused by loose pulley or improperly centered oil tube.
5. High pitched mechanical noise—faulty bearings.
6. Scraping—loose fan or cup not true.
7. Slight clicking of gear pump—not harmful. Will wear in.

pump to protect the latter in event the hand valve is closed.

Oil in Condensate—Should cylinder oil or other high-test oil enter the boiler with condensate, it will act as a non-conductor of heat and likely cause overheating of the tubes and furnace plates, as well as leakage at the seams and tube ends. Kerosene, if applied locally in sufficient quantity, will loosen and dissolve the coating of oil. An open flame must not be used in and around the boiler being treated with kerosene. Soda ash, if used in reasonable amounts will aid in the elimination of oil. After treating the boiler with soda ash, the contents of the boiler should be flooded out through an opening on top of the boiler shell such as the safety valve opening, since any active oil will float on the surface of the water in the boiler and can be removed from the top.

Boiler Cleaning

Tubes — Assuming burner operation has been normal and combustion good, there should be no undue accumulation of soot on heating surfaces. Manufacturers recommend that the furnaces and tubes be inspected after 30 to 90 days' operation to check for soot accumulation. Normally, with good oil and normal operating conditions, it should not be necessary to clean more than once every three to six months. Periods between cleaning can be lengthened by maintaining good combustion. Use of a wire brush is recommended to clean flues in firetube boilers. The use of air or steam to blow out tubes usually spreads too much dirt around the boiler room, and does not do as good a job as wire brushing followed by wiping with a rag wrapped around the wire brush. The stack temperature is the best indication of dirty tubes. When the stack increases by 75 to 100 F above normal, the need for cleaning is indicated.

Washing Out the Boiler—Boiler washout is also important, but depends upon so many local conditions such as type and quantity of raw water, make-up and type of water treatment used, that only general rules can be given. Where considerable make-up water is required, and unless the water treatment has been carried out under expert control, every new boiler should be opened after two or three months' operation and inspected for scale formation and sludge accumulation. This

will give some basis on which to establish future wash-out periods. It is often required that this washing out be done when the boilers are shut down for periodic inspection.

Oil Filter — When the boiler is equipped with a fuel-oil burner, some fuel-oil filters should be adjusted daily by turning the filter handle two or three revolutions. This will comb out accumulated dirt, and drop sediment into the bottom of the filter shell, from which it must be removed frequently. In other filters, the sediment basket should be removed and cleaned regularly. Failure to care for the filter properly may result in an undesirable drop in fuel pressure.

Strainers — During the first weeks of operation of a new boiler, frequent cleaning of all pipeline strainers is usually required to remove foreign matter which has been introduced into tanks and pipelines. Among such parts which must be checked for stoppage are the steam strainer on the oil-temperature regulator, suction strainers on the oil pump and boiler feed pump, oil strainer on the boiler front, and all steam-trap orifices.

Electric Service

The method of bringing electrical service to the boiler must follow the drawings provided by the boiler manufacturer for the particular installation. Sizes of entrance switches, wires, and fuses must comply with Code requirements for the loads indicated on the manufacturers' drawings.

It is extremely important that electrical connections be made as indicated in the wiring diagrams.

Each motor should be tested by starting it for a moment and observing if its direction of rotation is as required. If not, change the connections to the motor in accordance with the instruction tag or nameplate. Three-phase motors can be reversed by interchanging connections of any two motor leads at the starter.

Because the boiler has received actual operating tests in the factory, its internal wiring connections should require no change. Should it become necessary to replace any electrical control device or motor, all wiring connections must be plainly marked on both sides of the breaks in order that the device may be reconnected properly. Failure to use this ordinary care may require complete tracing of the internal wiring so that the various motors and controls will be properly interlocked.

Wiring that has been disconnected at the factory in order to dismantle parts preparatory to shipment is usually so marked or tagged that it can readily be reconnected if ordinary care is used. In case of question, reference should be made to the internal wiring diagram furnished by the manufacturer.

Operating Hints

Additional suggestions for operation and maintenance of packaged boilers are summarized as follows:

1. If the burner is forming carbon in the combustion chamber, proceed as follows: (a) check the oil temperature; (b) adjust the fuel-air ratio; (c) make sure that the air supply to the boiler room is adequate; (d) if the oil being used cannot be fired without forming hard carbon, change the type of oil.

2. Test low-water safety devices frequently by slowly lowering the water in the boiler to the level of cut-off, thereby determining if boiler-protection devices are in dependable operating condition.

3. The boiler should not be operated beyond the safe maximum stack temperature, approximately 650 F. Temperatures running more than 125 F above the steam temperature are a sure indication of one of the following conditions: (a) boiler is being fired beyond its maximum rating; (b) boiler requires cleaning; (c) broken refractories are permitting gases of combustion to short circuit on their way to the vent.

4. Lubricate motors and bearings at regular intervals, following manufacturers' recommendations.

5. Adjust the burner firing rate to approximate requirements of the steam load so as to minimize the number of starts and stops.

6. Do not continue firing the boiler after refractories show need of repair or replacement. A burned-out combustion chamber is likely to result.

7. To obtain maximum over-all efficiency of operation, it is advisable to proportion the air and fuel entering the combustion chamber so as to show a nearly clear stack with stack gases showing a CO_2 content between 12.5 and 13 per cent. Remember, clean heat-absorbing surfaces will show higher overall boiler efficiency than can be obtained by a higher combustion efficiency with soot-insulated heat-absorbing surfaces.

8. Punching hard carbon off refractories usually results in damaging refractories beyond repair, and necessitating replacement.

BOILER SHUTDOWN SUGGESTIONS

1. Reduce the load on the boiler gradually.

2. When boiler water level is low, raise level either to one-half or three-quarters of the gage glass. Shut off the water.

3. Extinguish the fire according to boiler manufacturer's recommended method. Draft fans should continue to operate until the boiler is purged of gases.

4. If oil fired, swing out the burner, and clean atomizing cup and air nozzle. For permanent shutdown, cover burner with water-proof cloth or paper unless standard cover plate is supplied.

5. When shutdown is temporary, and it is desired to keep oil circulating, keep electric heater on so burner lines remain warm.

6. Blow down the water column, the gage glass, and the feedwater regulator while there is still pressure on the boiler.

7. When boiler pressure falls below line pressure, non-return valve should close automatically, isolating the unit from those remaining in service. If no other boilers are in service, the stop valve should be closed when the boiler has cooled to insure no pressure build-up.

For Permanent Shutdown

A—Make sure the electric oil heater is turned off; then stop the oil pump, and shut off valves in the oil suction and return lines.

B—When boiler has cooled, drain out the water. Main stop valves and main feed valves should be always well locked and safeguarded.

C—Remove, test and store steam pressure gage and piping.

D—Wash out water side of boiler, making sure no sludge remains in shell or drums.

E—Clean tubes and furnace. Swab tubes and furnace with rag or mop dipped in crankcase or similar oil.

F—If boiler is located in moisture-free atmosphere, leave it open and allow air to circulate.

G—If boiler is located where dampness is prevalent, close up and fill to the steam nozzle with clean water.

H—Examine refractories and arrange for repairs if needed.

I—Check motors, belts and other equipment for wear, and order new parts as required. Motor brushes, commutators and switches should be checked for wear and replaced or refinished as required.

J—Clean and repair boiler auxiliaries and components, including water column, gage glass, gage cocks, injector, feed pump; also, condensate storage tank, chemical feeder and tank-level controls.

K—Clean and repair oil preheaters.

L—Remove, test and store oil pressure gages, suction gages, temperature recorders.

M—Clean oil-storage tank and oil lines. Clean and repair filters, strainers, check valves, foot valves, and line gate valves.

TYPICAL APPLICATIONS

THE AVERAGE self-contained boiler installation generates steam for a combination of process and heating loads, although many are installed for industrial heating alone. Some small plants generate electric power, using engine-generator sets and effectively utilizing the exhaust steam for heating water. As explained in a previous section of this article, the self-contained packaged steam generator meets all these conditions adequately and with maximum economy. Typical installations are illustrated here and on the front cover.

The cover illustration shows two 500-hp steam generators that operate at 150 psig and generate 35,000 lb of steam per hr. The steam is used for the catalytic cracking of natural and liquid-petroleum (LP) gases, making these higher Btu gases conform to the lower Btu value of manufactured gas. The cracked natural and LP gases are mixed with the manufactured gas and introduced into the city mains in a large eastern municipality piping system.

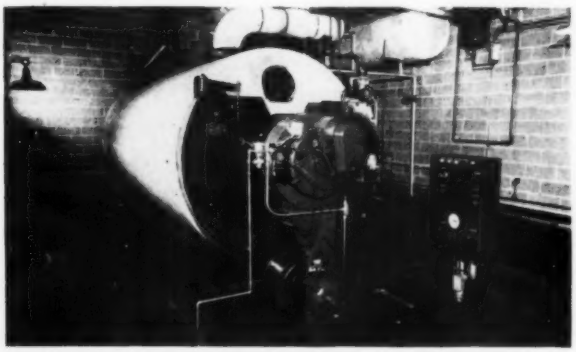
One of the illustrations shows an interesting installation at a metal-working plant on Long Island, N. Y. This plant is in an industrial building project where a number of buildings are grouped to form a modern factory site having unified transportation, utility, labor, and supply facilities. The operator in charge of this particular plant has many other duties throughout the building group, and depends on automatic operation of the 350-hp boiler for economical and continuous performance of the boiler in supplying the plant heating load.

The three 250-hp 15-psig boilers shown in another of the illustrations are installed in one of the repair shops maintained by the New York City Board of Transportation. Two 15,000-gal fuel storage tanks supply oil to the boilers via a loop system similar to the one shown in Fig. 21.

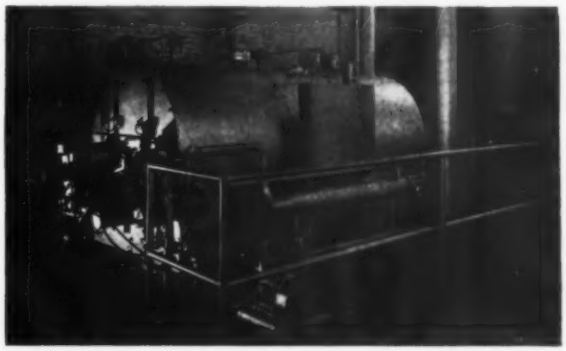
Another of the illustrations shows a water-tube packaged steam generator installed at an eastern bulk-storage plant of a major oil refiner. The boiler, designed for a maximum capacity of 14,000 lb of steam per hr, supplies 150-psig steam that heats heavy oils in large storage tanks to pumpable viscosity. The steam passes through coils placed within the storage tanks.

A packaged boiler, also illustrated, is installed at the plant of a wire manufacturer in Grand Rapids, Mich. It supplies steam for drying ovens that are used to bake enamel on all gages of wire during mild weather.

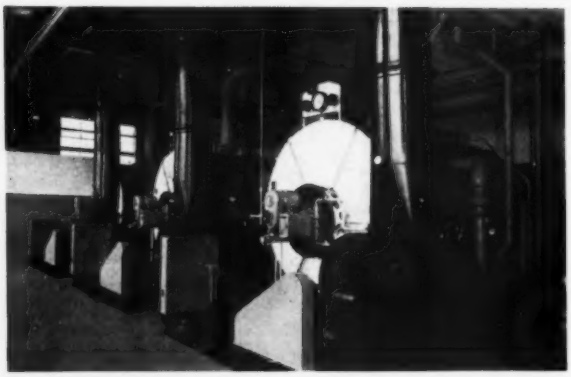
In compiling data for this article, the editors of INDUSTRY AND POWER visited many packaged boiler installations, including those illustrated and described herein. Additional information on actual installations was obtained direct from manufacturers. Installations so covered include those in the following industries: food, textile, paper, metal-working, pharmaceutical, railroad, chemical, bottling, automotive, office-supply, toy, cement, and aviation. Information was also ob-



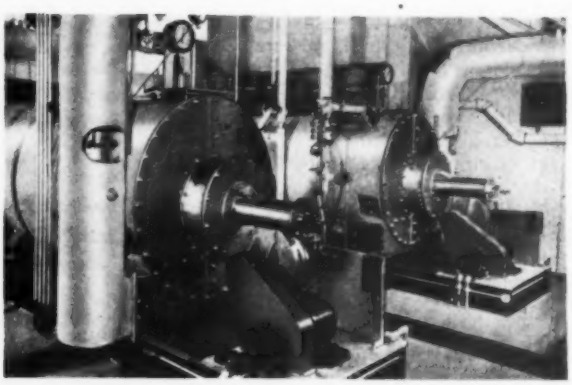
This 350-hp boiler carries heating load in metal-working plant that is part of centralized industrial project in Mineola, N. Y.



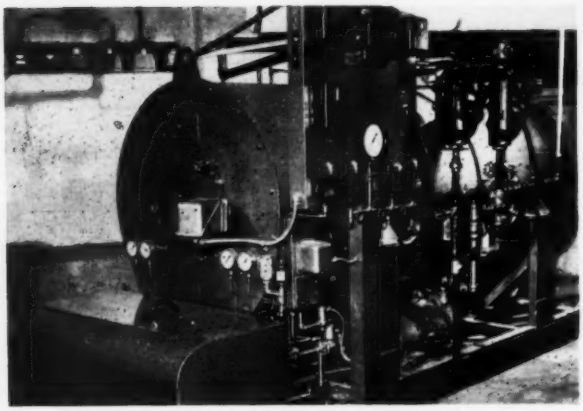
During mild weather, this single 100-hp unit carries the entire process-steam load for wire manufacturer in Grand Rapids



New York City Board of Transportation installed this battery of three 250-hp 15-psig boilers in its bus maintenance shop

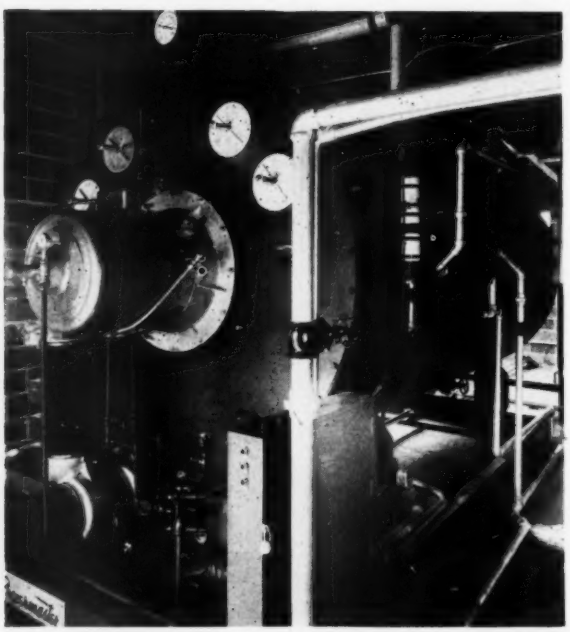


Two 80-hp boilers at a large hospital supply steam for heating, laundry, food preparation, and for sterilization equipment

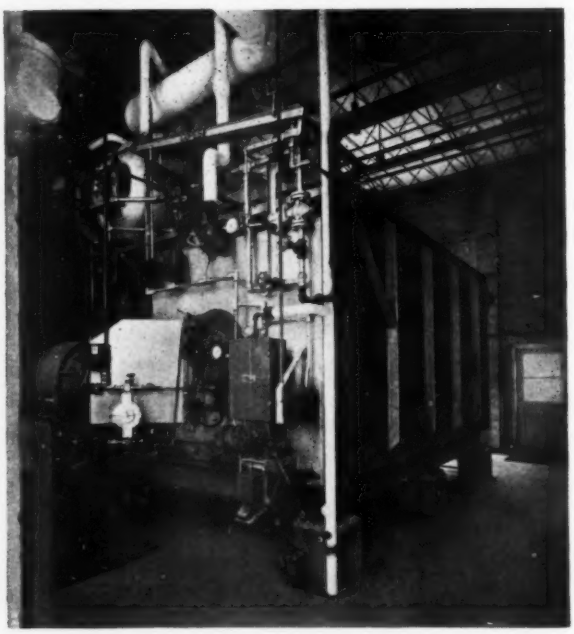


This is one of two 50-hp boilers used to process tobacco. Efficiency stays at 80% even during half-load periods.

Kitchen-ware maker installed two 300-hp boilers. Process and heating loads vary from 30 to 100% of boiler capacity.



Evaporating process in modern fish plant requires 14,000 lb of steam per hr. It is supplied by this automatic 400-hp unit



Oil refinery utilizes steam from this 14,000 lb per hr water-tube boiler to keep oil in storage at pumpable temperature

tained from installations in hotels, hospitals, universities, and research laboratories. Although this list obviously excludes many industrial and commercial fields, it does indicate the diversity of application of these boilers.

In all of these industries, there are many variables for any given boiler plant which govern the final answer as to the type of steam generator that yields the lowest over-all steam cost. Such variables include labor cost, investment cost, maintenance, and average boiler efficiency. During the past 15 years, the packaged steam generator has competed successfully with all forms of boilers and all types of fuels, and its present position in industry is evident that it has given a good account of itself on these costs.

ACKNOWLEDGEMENTS

The Editors of INDUSTRY & POWER appreciate the cooperation of the following packaged-boiler manufacturers in supplying data and information for this article:

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Hapman-Dutton Co.
Johnston Brothers, Inc.
Murray Iron Works Co.
Preferred Utilities Mfg. Corp.
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Superior Combustion Industries Inc.
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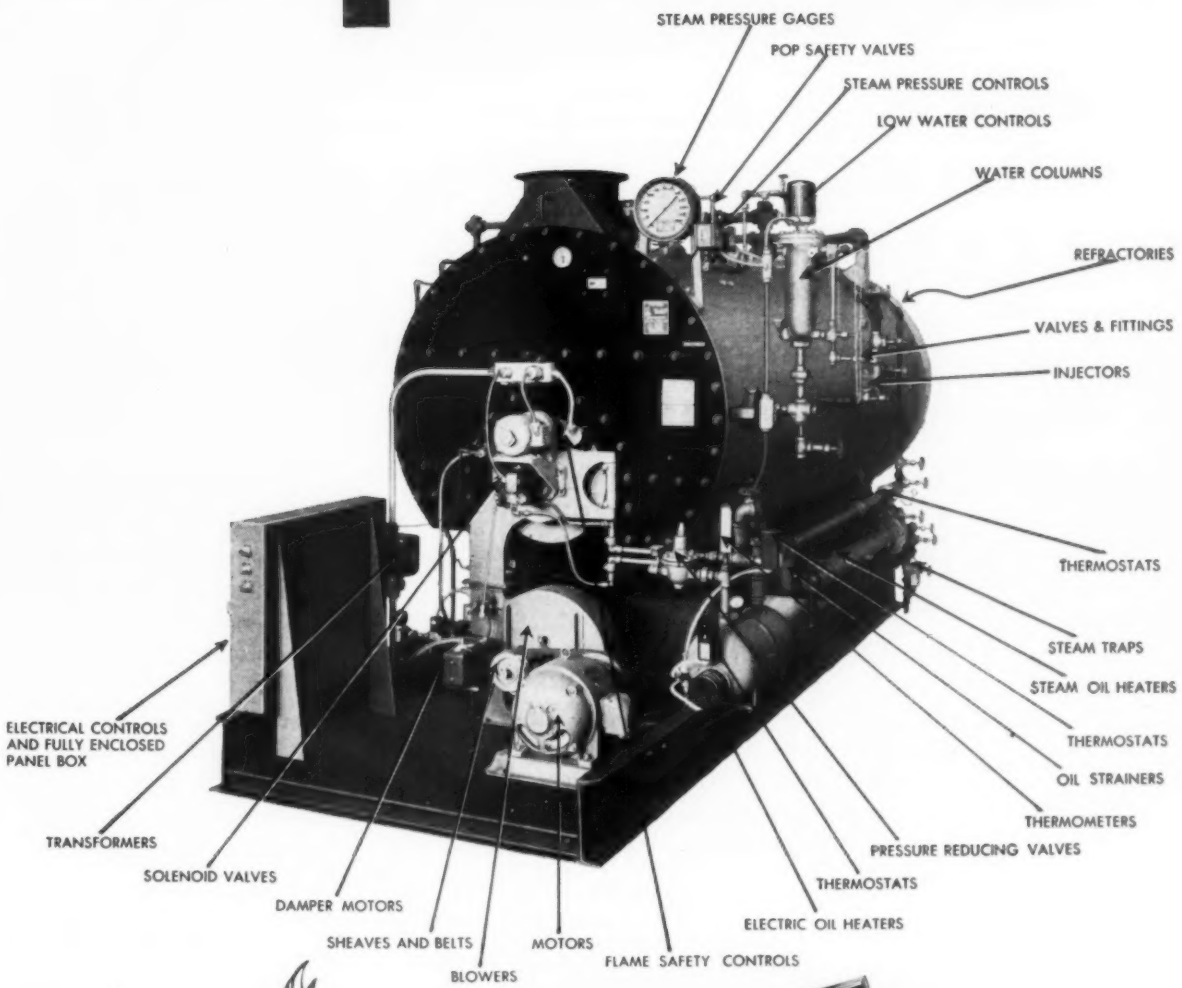

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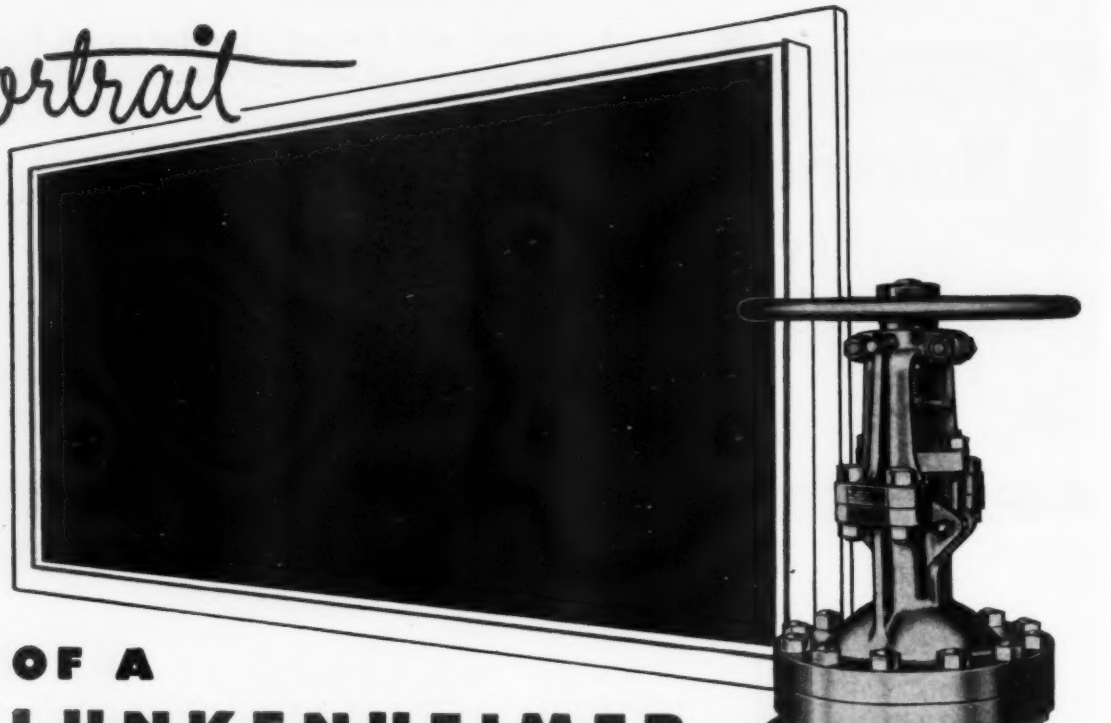

OF A LUNKENHEIMER STEEL CASTING

Short-wave Gamma rays search the steel of Lunkenheimer castings—probing for defects — making sure that the Lunkenheimer valves *you* buy are *sound all the way through.* Notice the smooth, even structure shown in this radiographic film. It is an x-ray portrait of steel valve strength, free from the telltale localized shadows that mark internal danger spots.

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WHY A BELT CONVEYER?

WILBUR G. HUDSON, *Consulting Engineer*

BELT conveyers have been installed as long as one mile or more between centers and are capable of handling over 3000 tons an hour. The discussion here, however, will be limited to problems involved in the average plant.

With a flat belt the conveyer is nicely suited for miscellaneous unit loads such as bagged mail, cartons, boxes, etc., usually with the belt sliding slowly on a steel or hardwood deck and with the return run supported on rollers.

On a downward incline, a gravity-roll conveyer may be better, but the pieces handled should not be heavy enough to sag the belt between rollers. There are limits to the down grade; if if it is too steep the load gains too much speed, if too flat the belt will not coast.

An incline of 1/2 in. per ft will do for cartons, 3/8 in. per ft for wood boxes weighing less than 75 lb and less for heavy rigid loads. With a belt the incline limit is reached when the parts carried tend to slip on the surface, usually somewhere around 25 deg. Cylindrical loads like bagged mail, may roll over and over if loaded crosswise.

Another alternative is the pallet conveyer with cross planks or steel sections carried on two strands of roller chain. This is best for miscellaneous freight, odd-shaped pieces, or those which might cut a belt, and for long transfers. Also there is the overhead carrier fitted with suspended trays or hooks. This machine has the advantage that it can follow almost any course with horizontal and vertical curves. With booster drives it may be extended to almost any length.

Every plant has its own set of problems and it is useless to lay down dogmatic rules fixing the relative advisability or inadvisability of a belt conveyer. But it does warrant careful consideration where a main line is fed by shorter tributary lines from either side. These feeder lines can be gravity roll conveyers. At the junction points a simple mechanism prevents collision of oncoming loads with loads already on the belt.

Cotton and untreated canvas belts are satisfactory unless humidity varies widely. A gravity take-up is preferable if the line is long, as it maintains unchanging belt tension. For conveyers in exposed locations, a rubber-covered belt may be specified, but should be supported on rollers. The horsepower at the head shaft for horizontal conveyers may be approximated by:

$$HP = \frac{(W + w) \times f \times S}{33{,}000}$$

Where:
W is wt of load on belt, lb
w is weight of belt, lb
f is friction coefficient (see below)
S is speed, fpm

Values for f	Cotton or Untreated Canvas, %	Rubber Impregnated Canvas, %
Roller-supported belt	3 to 5	3 to 5
Steel deck	20	20
Hardwood deck	25	30

The equation does not take all factors into consideration, but it is close enough. Manufacturers who have kept accurate cost records state that mechanical handling provides lower costs throughout the productive and nonproductive operations. Compared with manual handling, the saving is seldom less than 25% and in some instances exceeds 90%. Handling represents from 1/10 to 3/4 of the direct labor payroll. Furthermore, at least 70% of the time materials remain in the average plant is consumed in handling and holding them in storage. Aside from direct handling-cost reductions there are the corollary advantages of smooth material flow, reduction of lost time by skilled machine operators, and fewer accidents. Workers appreciate the last.

The troughed belt conveyer usually is a preferred method for handling bulk material where the arrangements permit an incline within limitations. A most important field is the conveying of coal from cars to bin or bunker. To a greater degree than with other conveyers, performance depends on intelligent supervision. Overload releases do not take care of contingencies injurious to the belt—a stuck or broken idler, a fragment lodged in a chute or jammed in the belt cleaner, or belt misalignment. These do not increase belt pull enough to operate safety devices

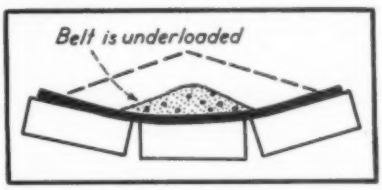

Fig. 1—A fully loaded belt means less wear, less load slip, no waste motion

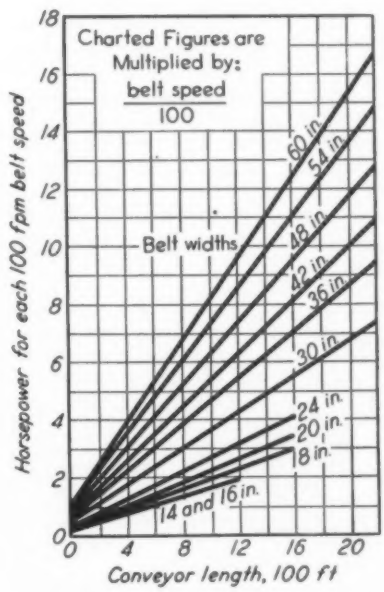

Fig. 2—Power to drive empty belt with idlers having anti-friction bearings

The alternative selections may be an inclined flight conveyer, a skip hoist, bucket elevator, or continuous flow elevator. Advantage of the skip is that it costs substantially less than a conveyer with supporting structure, but usually there must be a surge hopper, feeder, and overhead distributing conveyer.

Advantage of a flight conveyer is that inclines up to 35 deg are possible as against 18 or 20, and sometimes it is preferred for small, sticky coal. The continuous-flow machine is good for small capacities, but must be considered with caution for damp, corrosive or abrasive material. It costs far less, however, than either a conveyer or skip hoist.

If the layout can be arranged so there is a straight run from the loading point to the discharge pile, and beyond, for future extension, a single inclined and horizontal belt conveyer has desirable features. If the conveyer must approach a long storage pile at 90 deg, a shuttle conveyer is not too bad, considering that on 100 ft centers it will build a pile more than 200 ft long.

Pivoted Bucket Carrier

In boilerhouse work, another alternative is the run-around pivoted bucket carrier. This machine is remarkable for long life and low maintenance costs. Many now in service were installed forty years ago, with maintenance costs (for material only) of $0.0005 per ton. Its major advantage is its suitability for both coal and ashes. Today ashes usually are handled by a pneumatic or hydraulic conveyer, and a carrier costs much more than in the old days, so it is not specified for boilerhouse coal handling as formerly.

Where storage is in a silo adjacent to the siding, with live storage above a shelf and a reserve below, bucket elevators and continuous-flow elevators have the advantage that they can receive and reserve material by gravity flow and elevate it to live storage. Characteristics of some materials strongly favor the belt conveyer, for instance wet wood chips, sand, gravel, heavy ores, etc., which are tough for a flight conveyer.

Maintenance Costs. It is difficult to get good data on belt conveyer maintenance. The figures usually include expenditures for the feeder, crusher, or other auxiliary equipment. One coal handling installation with a 30 in. by 300 ft and a 30 in. by 400 ft conveyer had a maintenance cost — including apron feeder ahead of the first—of $0.0009 per ton for 449,000 tons in eleven years, and the belts were in excellent condition.

Another plant with a single 36 in. by 300 ft conveyer inclined at 20 deg and with rather tough loading conditions, with records from 1929 to 1936, during which 1,146,000 tons were handled, showed only one belt replacement in 1936 at a cost of $2,000. Including this, the maintenance cost was $0.0017 per ton. This is misleading as the belt just installed is included, and would no doubt be good for seven more years of useful life.

One frequent error conducive to high operating cost is running a belt too fast for the load it carries. With a belt partially loaded only the center part is used and eventually is worn through while the outer zones remain untouched, Fig. 1. Often the tonnage that can be handled may be trebled by full loading and there is less abrasion, less load slip, and less wasted motion of machinery parts.

Easing of load impact is important. Where heavy lumpy material is handled belt life can be increased from 10 to 20 times by using yielding instead of rigid idlers under the loading point. Sometimes it is difficult to impress an attendant with the fact that sealed anti-friction idlers do not require frequent shots of lubricant. Surplus grease is forced through the delicate labyrinth seals onto the underside of the belt.

A test was made on a conveyer handling coal, by soldering up the grease openings so only original grease was in the bearings. After ten years the idlers were dismantled and the bearings were in practically the same condition as when installed. It is essential to know whether oil-sprayed coal must be handled. The oil quickly destroys the belt, if cover is of natural rubber.

Neoprene and some other synthetics resist this action. Frequently calcium chloride is sprayed on coal to retard freezing. This does not affect the rubber, but it does injure the carcass. A vulcanized splice after initial stretch is well worth the expense. Cleaning residue from the belt cover usually is done with a weighted scraper, but if this is not effective a high-speed rotary bristle brush bearing lightly against the belt surface may be tried.

More effective is a cleaner made of diagonal strips (herringbone fashion) of stainless steel. Some materials are so adhesive they can be dislodged only with high-pressure water jets. A scraper bearing against the face of the lower snub pulley of the tripper prevents a build-up that causes the belt to run off-center.

Handling capacity for troughed belts at various speeds is given in Table 1. Power required to drive the belt is the total of that required to drive the empty belt, Fig. 2, plus that required to convey the load horizontally, Table 2, plus that required to lift the load, which equals tph $\times$ (Lift in ft $\div$ 1000). If a tripper is propelled by the belt allow about 3 hp and the same for a cleaning brush, in the middle capacity range.

BIBLIOGRAPHY

"Industry and Power", January 1947, February 1947, June 1947, April 1949, December 1949. "Belt Conveyors & Elevators", Hetzel & Albright, Wiley. "Conveyors & Related Equipment", Hudson, Wiley.

TABLE 1—CARRYING CAPACITIES OF TROUGHED BELTS*

Width of belt, in.	Weight of material, lb per cu ft						
	30	40	50	75	100	125	150
	Capacity, t p h at 100 ft per min belt speed**						
12	7	10	12	18	24	30	36
14	10	14	17	25	34	42	51
16	13	18	22	33	44	55	66
18	17	22	28	42	56	70	84
20	20	27	34	51	68	85	102
24	30	40	50	75	100	125	150
30	47	63	79	118	158	198	237
36	69	91	114	171	228	285	342
42	97	130	162	243	324	405	486
48	130	172	215	322	430	538	645
54	162	215	270	405	540	675	810
60	207	275	345	517	690	862	1035

* These are average duties in daily runs, not possible maximum loads. With a feeder giving continuous full loading the capacities may be exceeded. For grains, the capacities will be approximately 85% of those listed.

** Tonnage capacity proportional to speed; for example, at 200 ft per min, tons per hour are twice table values. Source: ***United States Rubber Company.***

TABLE 2—POWER REQUIRED TO CONVEY MATERIAL HORIZONTALLY

Conveyer length, ft	25	50	100	150	200	250	300	400	500	750
Power required per 100 tph, hp	0.31	0.41	0.62	0.83	1.04	1.25	1.46	1.88	2.30	3.35

For other rates of handling, multiply the tabulated figures by tph/100.

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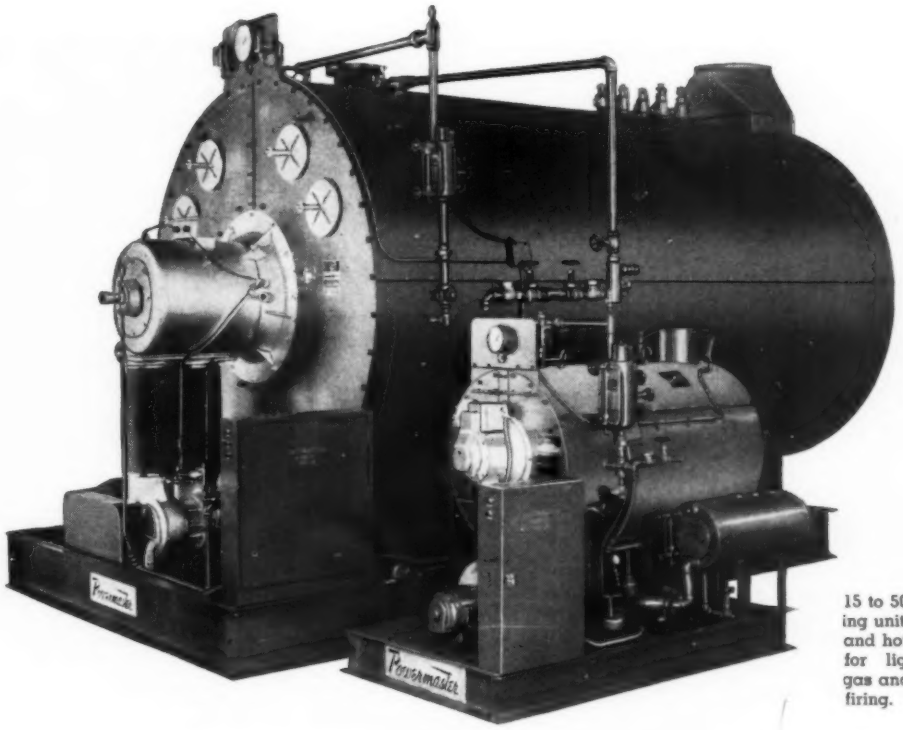

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Spot News

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants.

Processed Wood Provides Good Floor Insulation For Metal-Enclosed Switchgear at Seattle Plant

To overcome a bus fault in metal-enclosed drawout direct current switchgear, the City Light Co., Seattle, Wash., recently designed three 1,500 kw, 600 v rectifiers so they are electrically insulated and isolated from ground at the First Hill sub-station.

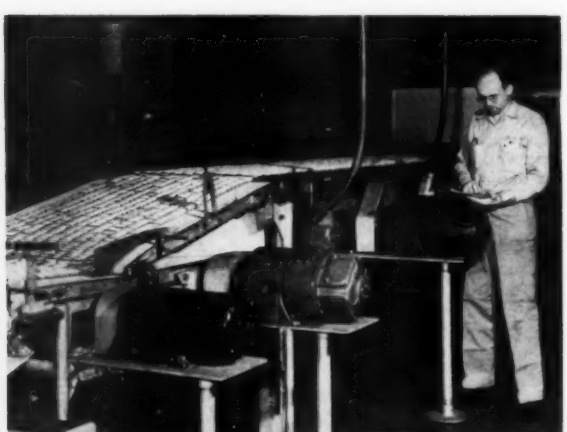
Two layers of Masonite Presdwood were used to insulate the circuit breakers, bus and control panels from the floor. The first layer, in panels four feet square, was Standard Presdwood, and the top layer was Tempered Presdwood, edges of which were slightly beveled.

Company officials said Presdwood was chosen for the flooring surface because of its good insulating properties, low cost and ability to stand heavy loads. The small trucks which are used to roll in replacements for removable circuit breakers bear a load of approximately one ton each.

Co-ordinated Drive for 600-ft Long Bakery Line

At the Keebler Weyl Baking Co. in Philadelphia, 26 General Electric Thy-mo-trol units are providing a co-ordinated drive on the 600-ft long production line. This line makes a number of biscuit-type baked products, forming them with a cutting machine at the entrance, baking them in a continuous band oven, stacking them on the cooling conveyers, and packaging them at the delivery end.

According to Charles L. Taylor, the bakery's electrical engineer, the flexible electronic motor controls with gear motors enable the company to maintain co-ordination and make adjustments easily and efficiently on the production line. Especially important at Keebler, the units provide a sanitary installation and require a minimum space, which facilitates maintenance work considerably.



Large blast furnace turbo blower in foreground was recently installed by Dravo Corp.'s machinery div. at Edgar Thomson Works of Carnegie-Illinois Steel Corp. The new De Laval machine has a capacity of 121,000 cu ft of blast air per min while the other two can each supply 90,000. The turbo blowers are designed for 650 psi and 750 F at the throttle

Patents Released by Atomic Energy Commission

Here are patents owned by the United States government and held by the Atomic Energy Commission which may interest engineers and manufacturers.

The commission will grant non-exclusive, royalty-free licenses on the listed patents and applications, as part of its program to make non-secret technological information available for use by industry.

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title.

Patent No. 2,514,115, title: *Method of Dissolving Difficultly Soluble Metal Sulfates*, issued July 4, 1950 to A. H. Angerman.

Patent No. 2,514,116, title: *Induction Reamer*, issued July 4, 1950 to W. R. Baker. An unattached circular tool carrying a squirrel cage winding can be rotated inside a tube by means of a rotating magnetic field generated through the squirrel cage winding.

Patent No. 2,515,159, title: *Quick Operating Valve*, issued July 11, 1950 to E. Zurcher.

Patent No. 2,516,050, title: *Adjustable Centrifugal Switch*, issued July 18, 1950 to Q. J. Evans and A. Kushner.

Patent No. 2,517,863, title: *Voltage Supply Circuit for Vacuum Tubes*, issued August 8, 1950 to D. K. Froman.

Patent No. 2,521,112, title: *Method for Separating Fluids*

by Thermal Diffusion, issued September 5, 1950 to J. W. Beams. Two thermally conducting parallel tapes are moved in opposite directions to conduct lighter and heavier components counter current to each other.

An application for a patent, Serial No. 664,957, title: *Precipitation Process and Apparatus Therefor,* inventor L. G. Stang, Jr. Liquid within a precipitation chamber is maintained above a porous member by introducing air beneath the member. When pressure beneath the porous member is reduced the liquid is sucked through the member and filtration is effected.

Expand Facilities at Little Rock Lamp Plant

The Westinghouse Electric Corp. will add a 100,000 sq ft wing to its lamp plant in Little Rock, Ark. According to Ralph C. Stuart, Westinghouse v-p, expansion of the company's westernmost lamp plant would increase its floor space by two-thirds and enable full capacity operation.

The construction firm of Ditmars, Dickmann, and Peckens of Little Rock has been awarded the contract for the design and construction of the addition, which will have a 200-ft front and be 516 ft long. Completion is scheduled for April 1951.

Aluminum Crossarms Installed on Standard Steel Transmission Towers

The first known installation of aluminum crossarms on standard steel transmission towers has just been made on the Duquesne Light Co.'s Phillips-North line near Ambridge, Pa. Approximately 24,000 lb of aluminum structural angles were used in the crossarms.

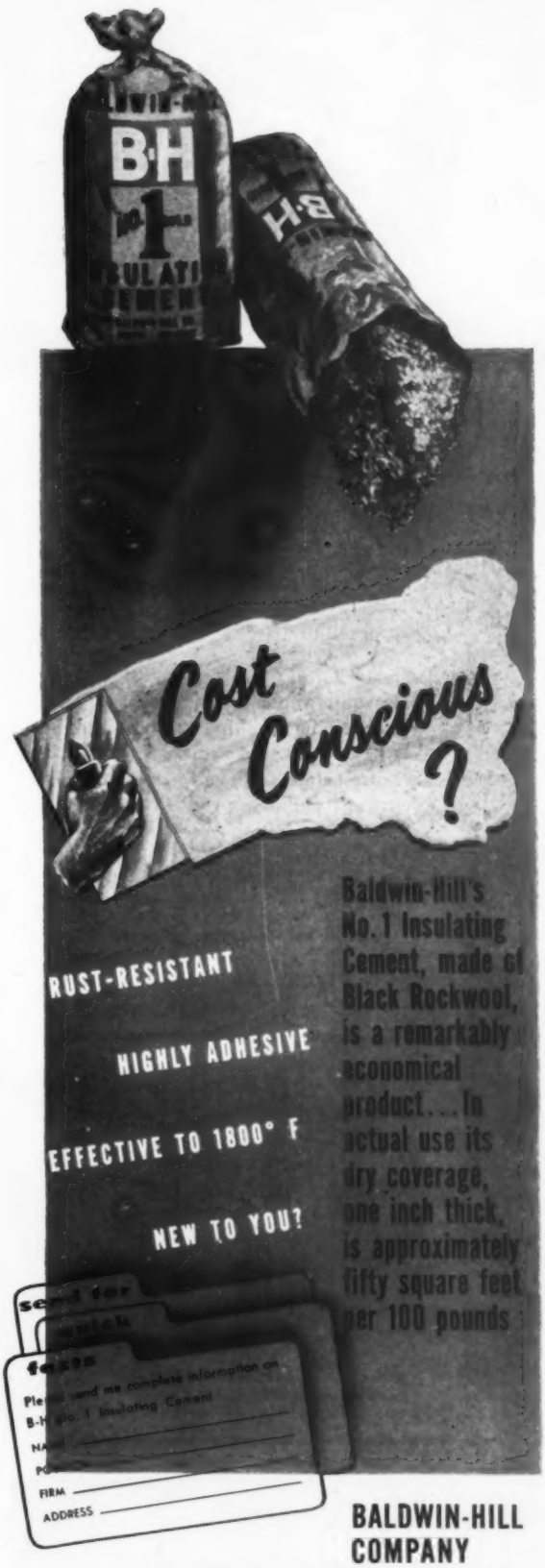
An aluminum alloy with high resistance to corrosion was used. Since the line will not have to be shut down for painting the crossarms, another step toward uninterrupted service will be accomplished.

Large-Scale Production of Gas Turbine Power Plants

Large-scale production of gas turbines, latest type of power plants for land, railroad and marine use, has been started at the General Electric Co's Schenectady, N. Y., plant. Fa-

NEW TICOSTEAM PACKAGED UNITS

The Titusville Iron Works, division of the Struthers-Wells Corp., announces its entry into the "Packaged" steam generator field. The units are equipped to operate on gas or oil (of any viscosity) or to operate interchangeably with a combination of the two. The Ticosteam generators shown are for 5175, 2070, and 5175 lb steam per hr respectively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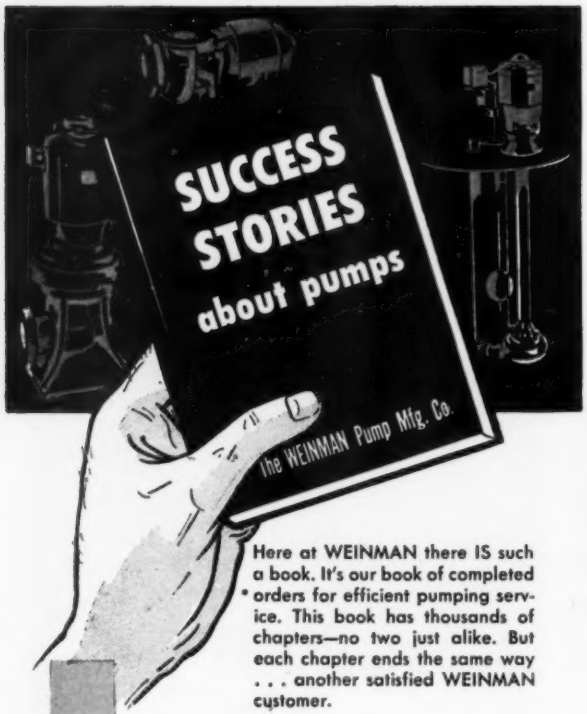

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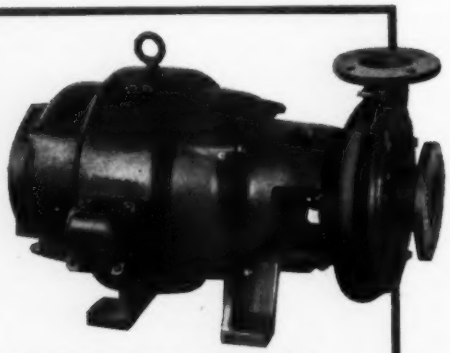

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cilities are now being equipped at a cost in excess of $4,000,000, the company states.

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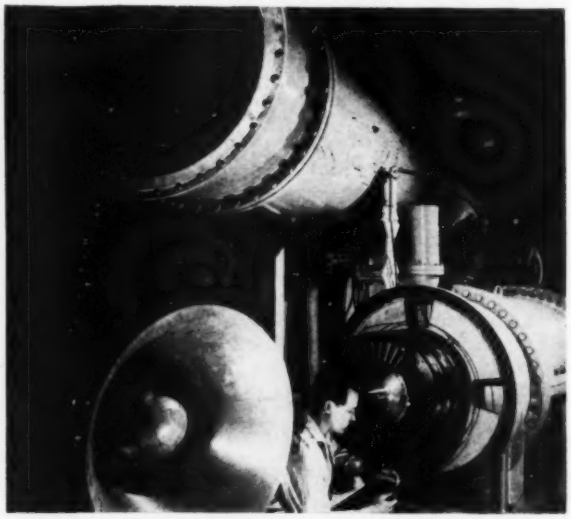
(Continued on page 140)



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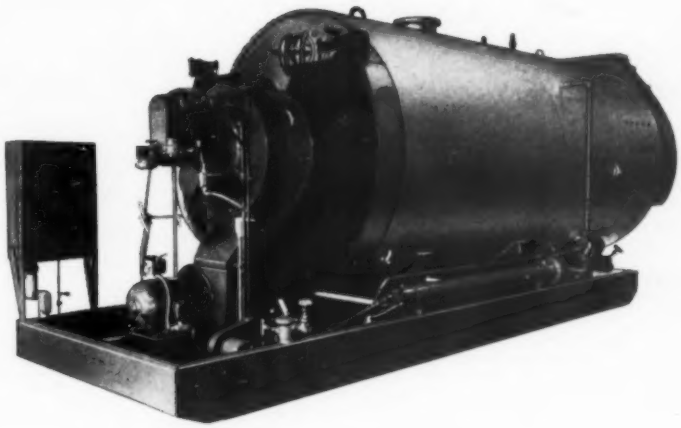

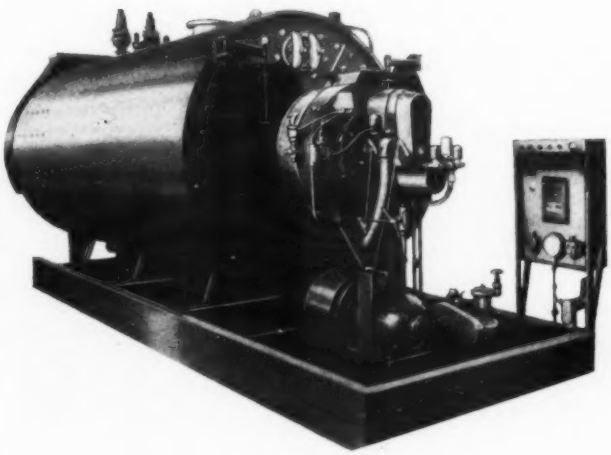

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readers' guide to advertised products

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5—See page 134. Firebox Type Boilers: Especially adapted for high pressure—10 to 304 hp, 100, 125, 150 lb wp. Send for full information and free 6 in. scale with pipe diameter markings. Kewanee Boiler Corp.

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13—See page 130. Vacuum Cleaners: Write for Bulletin A-794. Gives full information on Hoffco-Vac $50—all purpose, two-sweeper machine! Bulletin A-650 gives details of centrifugal blowers and exhausters. Write today. U. S. Hoffman Machinery Corporation.

14—See page 32. Axial Flow Blowers: Wing turbine blowers save valuable floor space, avoiding duct work and large space requirements. Write for copy of Wing Bulletin No. SW-50. L. J. Wing Mfg. Co.

15—See page 145. Combination Blower-Suction Cleaner: It's a snap to rid all of your equipment of damaging dirt, dust, and grit with this portable cleaning tool. Write for more data. Clements Mfg. Co.

16—See page 127. Axial Flow Blowers: Write today for full information about Standardaire Blowers with precision roller bearings and labyrinth type oil seals. The Standard Stoker Co., Inc.

COMPRESSORS

17—See page 67. Rotary Compressors: Send for Bulletin C-5. Packed with detailed information on these quality compressors—designed and built to give a life-time of new machine service. Write today. Fuller Company.

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards, page 117. Mail today—postage-free!

DIESEL POWER

18—See page 113. Diesel Engines: For a complete line of engines of the type and size to meet your requirements exactly, write for details on Superior—Atlas line. The National Supply Company.

DUST & FLY ASH COLLECTING EQUIPMENT

19—See page 46. Electrical Precipitation: Write for your free Bulletin 500 which presents full information on the Cottrell Precipitator. It effectively cleans stock gases by removing over 95% of all fly ash particles. Research Corporation.

ELECTRICAL EQUIPMENT

20—See page 61. Mica-Glas Insulation. For absolute dependability on your electric windings, use Mica-Glas. Write for full details. National Electric Coil Company.

21—See pages 18, 19. Mechanical Rectifiers: Write today for I-T-E Bulletin 4809. Gives full technical details about widely used I-T-E mechanical rectifiers. I-T-E Circuit Breaker Company.

22—See page 146. Snap-On Volt-Ammeter: Pocket-size instrument determines load conditions without necessitating shut down of equipment. Spots motor overloads and underloads. Write for free manual. Pyramid Instrument Corp.

23—See page 135. Voltage Regulators: Write today for complete information on Stabiline Electromechanical voltage regulators. Available for a wide range of applications. The Superior Electric Company.

24—See page 42. Time-Delay Fuses: New Economy Catalog gives full data on renewable cartridge fuses for protection where time delay is most needed—135 to 200% overloads. Economy Fuse and Mfg. Co.

FLOOR REPAIRS

25—See page 145. Floor Patch: Tough, plastic material restores broken concrete to solid smoothness. Write for details of free trial offer and hand book Flexrock Company.

(Continued on page 112)

STOP RUST!

YOU can STOP RUST . . . PREVENT RUST...on *any* rustable metal surface with RUST-OLEUM. Every day, rust eats away on your metal tanks, buildings, fences, stairs...everything metal inside and outside your plant. Yet, rust *can* be stopped and protection given economically with RUST-OLEUM.

For more than a quarter of a century RUST-OLEUM has been *proved* under severe conditions of weather, fumes, salt air, salt spray, and other rust producing conditions. Railroads, shipyards, builders, refiners...nationally known users* in almost every field of industry...have found RUST-OLEUM the economical way to stop rust and prevent further rust. Architects, builders, engineers, maintenance men now specify RUST-OLEUM for primer, "shop coat", and finish coats.

RUST-OLEUM adds extra life to metal buildings, equipment and other metal surfaces and can be applied over already rusted surfaces without extensive surface preparation. Yet, RUST-OLEUM costs no more than most quality materials.

RUST-OLEUM not only protects — it beautifies as well! RUST-OLEUM is available in a large selection of colors including aluminum and white. It spreads evenly...and dries free of brushmarks in 4 to 12 hours, depending on conditions, to a tough, pliable film that protects against rust.

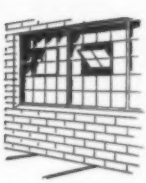
Be sure you get *only* genuine RUST-OLEUM for positive protection against rust! Specify RUST-OLEUM to your contractor or architect on any new construction, remodeling or maintenance work.

RUST-OLEUM is stocked and sold by leading industrial distributors in all principal cities of the United States and Canada. See Sweets for complete catalog and nearest source of supply, or write us direct for complete information.

**Names on request*

RUST-OLEUM CORPORATION

2474 OAKTON STREET — EVANSTON, ILLINOIS



reader's guide to advertised products

(Continued from page 110)

FUELS AND FIRING EQUIPMENT

26—See pages 38, 39. Induced Draft Fans: Sturtevant Turbovane fans give you the exclusive errosion resistant wheel that cuts downtime and maintenance cost to a new low. Write for full details. Westinghouse Electric Corporation, Sturtevant Division.

27—See page 34. Baffles: Enco streamlined baffles give you 4 major values—better heat transfer; low draft loss; less steam and time for cleaning; custom installation. Write for Buletin BW44 for full details. The Engineer Company.

28—See page 23. Gas and Oil Burners: This company manufactures burners for every heating and power need—combination gas and oil burners, for either vertical or horizontal firing. Write today for free literature. John Zink Company.

29—See page 120. Fuel Oil Additive: Houghto-Solv dissolves all the sludge in your entire system—cleans tanks, lines, strainers, pumps, nozzles, etc. Write for free descriptive folder today. E. F. Houghton & Co.

30—See page 137. Burners: Let skilled Todd specialists help you achieve maximum economy in your boiler plant—either by modernizing obsolete equipment or providing new installation. Write for details. Todd Shipyards Corporation.

31—See page 121. Mechanical Draft Fans: Years of experience make Green an authority as a manufacturer of high-efficiency, low-operating cost draft fans. Write for Mechanical Draft Fan Bulletin 168 today. The Green Fuel Economizer Co.

HEATING, VENTILATING AND AIR CONDITIONING

32—See page 24. Unit Heaters: Write today for details of this complete range of well graduated sizes, in horizontal and blowdown types, of these unit heaters built for maximum output at minimum cost. Fedders-Quigan Corporation.

33—See page 15. Strip Heaters: Chromalox heaters make clean, dependable and accurately controlled heat a certainty. Give round-the-clock service. Write for Bulletin "100 Ways to Apply Electric Heat". Edwin L. Wiegand Company.

34—See page 150. Fans and Blowers: Hartzell systems remain trouble-free year after year; keep operating costs at minimum. Send coupon for free information or free consultation with Hartzell field representative. Hartzell Propeller Fan Co.

35—See page 135. Air Conditioning: Niagara "Controlled Humidity Method" uses little or no mechanical refrigeration for dehumidifying. Saves space, maintenance expense, power. Write for more information. Niagara Blower Co.

HEAT EXCHANGERS

36—See page 12. Refrigeration Condensers: Free Bulletin RC-1 gives you complete details on horizontal and vertical types shell and tube condensers for every service. Be sure to write today. Henry Vogt Machine Company.

37—See page 138. Quintair Heat Exchanger: Type E gives you low cost, efficient cooling or condensing of liquids, gases or vapors. Full details are contained in free Bulletin No. 11.0-.080. Write today. J. F. Pritchard & Co.

38—See page 17. Fin Fan Heat Exchangers: Write today to reserve your new 8-page folder on Fluor GR Fin Fan heat exchangers—for gas cooling, vapor condensing, liquid cooling. Fluor Corporation.

INSTRUMENTS

39—See page 141. Venturi Meters: Write for full information and free bulletins on these top performance meters that record ALL the facts about boiler feedwater flow. Builders Providence.

40—See page 129. Panel Instruments: Weston instruments are designed to simplify and speed up electrical and electronic installations, production testing, and maintenance. Write for Bulletin A-7-B. Weston Electrical Instrument Corporation.

41—See page 141. Flow Indicators: Write for Bulletin S-1. Contains details on gage glass guards, flat gage glasses, and specifications of Ernst sight flow indicators. Write today. Ernst Water Column & Gage Co.

42—See page 144. Automatic Liquid Measuring Gages: Write for complete details on liquid level gages for measuring liquids of all kinds. Dial readings in feet, inches, gallons, pounds or any desired units. The Liquidometer Corp.

43—See page 148. Truscale and Trulevel Gages: Write for free, illustrated data units on these gages that give you accuracy for reading liquid levels in boilers, deaerating tanks, etc. Jerguson Gage & Valve Company.

44—See page 108. Ellison Instruments: Write for Bulletin 120 describing portable gas analyzer; Bulletin 9-F gives details on pitot tubes; Bulletin 118 covers U-path steam calorimeter. Send today. Ellison Draft Gage Co.

45—See page 134. Analysers: Send coupon for Bulletin 800-A on Gas Analysis. Data-packed pages have wide range of gas and analysis problems and their solutions. Charles Engelhard, Inc.

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards, page 117. Mail today—postage-free!

INSULATION

46—See page 107. Industrial Insulation: Send for new booklet on B-H Block insualtion made with black rockwool, flexible and easy to cut, fits tightly over irregular surfaces. Write today. Baldwin-Hill Co.

LUBRICANTS AND FILTERS: PURIFIERS AND LUBRICATORS

47—See page 133. Albany Grease: Send for your free sample of Albany greases together with descriptive literature of these famous-for-82 years lubricant. Adam Cook's Sons, Inc.

48—See page 145. Spray Valve: Farval Bulletin No. 60 will bring you complete data on the new Farval Spray Valve that meters lubricants to slide surfaces and open gearing. Write today. Farval Corporation.

49—See page 41. 11 Ways to Cut Production Costs: Write for your copy of this free, new booklet which is yours without obligation. You will find handy coupon on page 41. Alemite Corporation.

50—See page 139. Non-Fluid Oil: Send for instructive bulletin and free testing sample of Non-Fluid Oil for positive bearing protection. New York & New Jersey Lubricant Company.

51—See page 33. Colloidal Graphite: Write for full details about "dag" colloidal graphite for general lubrication, extreme temperature lubrication, parting, impregnation, and opaquing. Acheson Colloids Corporation.

52—See pages 35, 35. Industrial Lubricants: For minimum turbine-oil maintenance, use Nonpareil—often reduces lubrication costs as much as 68%—write for Engineer's services. Send, too, for "Stanolith Greases" a new booklet on how these greases solve wet-hot problems. Standard Oil Company (Indiana).

MAINTENANCE

53—See page 146. Free Repair Handbook: Filled with time saving. money-saving uses for Smooth-On in plants and shops. Clear, practical directions. 170 illustrations. Send today for your copy. Smooth-On Mfg. Co.

54—See page 111. Rust Preventive: Rust-Oleum seals metal so that no rust-causing oxygen can reach it. Available in a full range of colors. Write for complete catalog. Rust-Oleum Corporation.

MATERIAL HANDLING

55—See page 40. Bulk Materials Handling Systems: Stephens-Adamson engineers are at your service to solve your bulk materials handling problems quickly and economically. Write today. Stephens-Adamson Mfg. Co.

56—See page 143. Liftruks: Write today for Bulletin No. 76. Gives full data on heavy-duty Liftruks—5, 7½. 10 ton capacity. Silent Hoist & Crane Co.

57—See page 65. Materia's Handling Systems: Let Jeffrey engineers give you cost cutting solutions to your mate-

(Continued on page 114)

ATLAS
Imperial
DIESEL
ENGINES
Superior
Joining Two Great Names in Engines
Superior . . . Atlas . . . two world-famous lines of engines . . . now united by the purchase of the manufacturing rights of Atlas Diesel Engines by The National Supply Company.
Present owners of Superior and Atlas engines will benefit from the expanded sales, service, and shop facilities of the combined companies . . . from Alaska to Mexico and from Nova Scotia to Texas.
Manufacture of both lines of engines will continue on the same high standards as in the past. Production of both lines will be combined in Superior's modern 15-acre plant at Springfield, Ohio. The outstanding features of both Superior and Atlas engines will continue to make these two lines of engines the greatest values in their fields.
If you contemplate the purchase of engines, you will find the type and size to meet your requirements exactly in the complete Superior-Atlas line. Write for the location of the sales-service station nearest you.
THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio
Superior
ENGINES
ENGINE DIVISION
THE NATIONAL SUPPLY COMPANY
ATLAS
Imperial
DIESEL
ENGINES
DIESEL ENGINES . . . NATURAL GAS ENGINES . . . DUAL FUEL ENGINES

50 SERIES
FLOAT and FLOAT & THERMOSTATIC TRAPS
All working parts are mounted on the cover. Pressure range to 125 lbs. Capacities up to 12000 lbs. condensate per hour.
HOFFMAN
TRAPS
HOFFMAN RADIATOR TRAPS
Removable thermal units and seats are a distinguishing feature of Hoffman Traps, greatly simplifying clean-out and inspection work. Pressure range 0 to 125 lbs. Capacities up to 1250 lbs. condensate per hour.
600 SERIES
INVERTED
BUCKET TRAP
Straight-through pipe connections, all working parts connected to bonnet and easily removed with it. Interchangeable valve seats for various pressures. Pressure range 0 to 200 lbs. Capacities up to 5000 lbs. condensate per hour.

Here's two easy steps to "more heat from less fuel" for next winter.

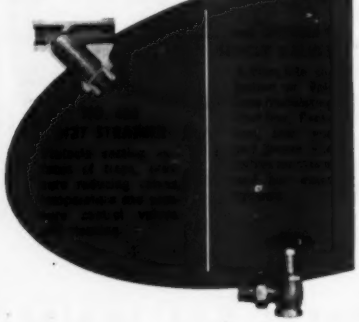
First, check carefully all valve pins and seats of steam traps and replace units which are not functioning.

Second, install additional valves, traps or pumps where good steam-plant engineering indicates their need.

And, here's the big pay off, once Hoffman Traps are installed, it's a simple matter to make periodic inspection—as all working parts are mounted on the covers, easy to get at. Modernizing your steam plant with Hoffman Specialties is obviously not an expense, but a long term investment paying immediate dividends in lower operating costs.

HOFFMAN SPECIALTY COMPANY, Dept. IP-11, 1001 York St., Indianapolis 7, Ind.
Famous for HOFFMAN VALVES, TRAPS, VACUUM AND CONDENSATION PUMPS, FORCED HOT WATER HEATING SYSTEMS—Sold by leading Wholesalers of Heating and Plumbing Equipment

HOFFMAN
Steam
TRAPS



readers' guide to advertised products

(Continued from page 112)

rials handling problems. Complete line of material handling, processing and mining equipment. Write for full details. The Jeffrey Manufacturing Company.

58—See page 133. Pneumatic Conveyors: These Dracco conveyors save you money six ways. Check them in the advertisement—then write for further information. Dracco Corporation.

59—See page 47. Coal Handling Equipment: Write for free Bulletin No. 300. Outlines four basic types of coal handling systems. Brings coal handling costs down to minimum. Gifford-Wood Co.

60—See page 124. Vibrating Screens: Whatever your needs in vibrating screen equipment, Hewitt-Robins can fill them. Write for full information. Hewitt-Robins Incorporated.

PACKINGS AND GASKETS

61—See page 138. Palmetto Kups: Free Bulletin MP-20 describes Palmetto compositions that never dry out. Send today. Greene, Tweed & Co.

PIPE AND FITTINGS

62—See page 122. Ball-Bearing Swivel Joints: Catalog No. 50 gives full information on more than 500 different types, styles and sizes Chiksan Ball-Bearing Swivel Joints. Write today Chiksan Company.

63—See page 64. Flexible Metal Tubing and Metal Hose: Write for literature describing the many uses and types for handling steam, water, oil, solutions, semi-solids, or gases. American Metal Hose Branch, The American Brass Company.

64—See page 144. Flexible Metallic Hose: "Atlantic" metal hose survives most extreme conditions. Seamless or interlocking, in bronze, steel, stainless steel, monel. Write for Catalog 100. Atantic Metal Hose Co., Inc.

65—See page 13. Copper Tubes for Industrial Applications: Booklet C-24 describes copper tubes and fittings for plumbing, heating, mechanical and process uses. The American Brass Co.

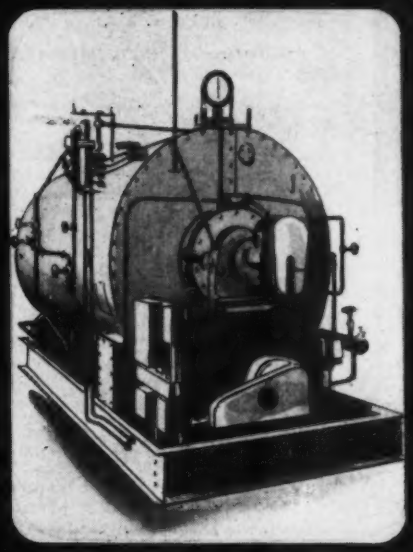
PLANT EQUIPMENT

66—See page 145. Uni-Truks: Form 757-1 gives you full data on these extra strength hand trucks. Write today Standard Pressed Steel Co.

POWER TRANSMISSION

67—See page 68. Whipcord Endless Belts: Manufactured to meet drive needs of constant take-up and heavy idler tension, these belts have remarkably low inelastic stretch. Insure years of trouble-free service. Write for full

(Continued on page 116)



WHY PACKAGED BOILERS NEED DEARBORN WATER TREATMENT SERVICE

HOW DEARBORN MAKES THIS VITAL SERVICE AVAILABLE TO YOU

WHY! There is no essential difference—except size—in the operation and maintenance of packaged boilers and the largest boiler installations. Packaged boilers, whether in large or small plants, are vulnerable to all the consequences that may result from untreated or inadequately treated water. But, it is also true that a properly conceived and administered water treatment program will save time and money by increasing the efficiency of your packaged boilers.

HOW! In the same way—with the Dearborn Industrial Water Treatment and Engineering Service—that the largest boiler installations are kept at highest operating efficiency. Dearborn has for years maintained a program designed particularly for packaged boilers, including (1) laboratory analysis; (2) treatment recommendations and adjustments; (3) continuing test procedures; and (4) proportioning pumps and feeders. This service is available to you.

WRITE! The Dearborn Plan for Packaged Boilers puts all the facilities and years of experience of Dearborn chemists, engineers and technicians at your service. Write for complete information about this plan and how it will produce substantial savings for you. The coupon is for your convenience.

DEARBORN CHEMICAL COMPANY
310 S. Michigan Ave. • Chicago 4, Ill.

Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

Dearborn Chemical Company
310 South Michigan Avenue, Dept. INP
Chicago 4, Illinois

Please send complete information on the Dearborn Plan for Packaged Boilers.

Name.....

Company.....

Position.....

Address.....

City.....*State*.....

Another Installation Of

BOILERS BY BIGELOW

For Efficient Steam Production

Bigelow Type F and FH water tube boilers are designed and built to give you efficient and economical steam production.

The baffles are arranged to assure maximum heat pick up which means lower stack temperatures. The rear passes are baffled so that the cross section area is restricted, compensating for the decreased volume of the partially cooled gases.

Bigelow Type F and FH boilers are available in capacities from 20,000 to 100,000 pounds of steam per hour. Design pressures range from 160 to 450 lbs. p.s.i. These boilers are designed for oil, coal or gas firing.

For further information, write for Bigelow's catalog or contact your nearest Bigelow representative.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

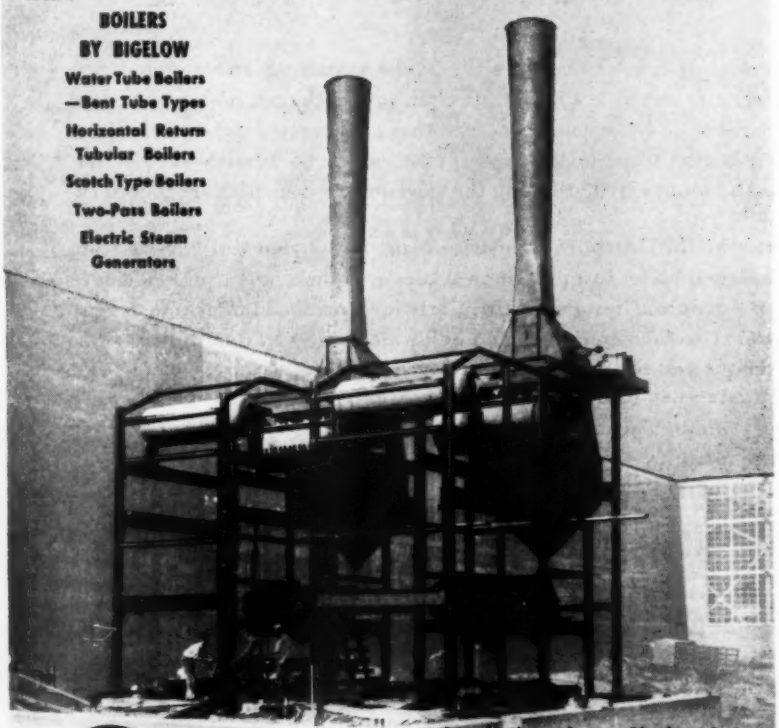
ESTABLISHED 1833

BIGELOW REPRESENTATIVES: *Boston • New York • Philadelphia • Syracuse • Detroit • Chicago • Pittsburgh • Milwaukee • New Orleans • Baltimore • Petersburg, Va. • Washington, D.C. • Albuquerque • Seattle • Sumter, S.C.*

BI-1

BOILERS BY BIGELOW

Water Tube Boilers
—Bent Tube Types
Horizontal Return Tubular Boilers
Scotch Type Boilers
Two-Pass Boilers
Electric Steam Generators



Installation of two Bigelow Type FH boilers at Detroit Steel Co. Each boiler is water-walled. Setting is made up of fire brick tile, insulation block and steel casing. Each boiler is spreader stoker fired and equipped with induced draft fan and dust collector.

readers guide to advertised products

(Continued from page 114)

details in Bulletin 6869-D. Raybestos-Manhattan, Inc.

68—See pages 58, 59. Chains: This company specializes in the manufacture of sprocket chains, sprockets and attachments. An inquiry will show you how this specialization means better service to you. The Union Chain and Mfg. Co.

69—See page 144. Worm-Gear Sets and Speed Reducers: Write for latest Cleveland Catalog of Cleveland's complete line. They'll meet the needs of any machinery or equipment builder or user. Be sure to outline your requirements. The Cleveland Worm & Gear Company.

70—See page 43. V-Belts: When you buy V-belts, be sure to specify Gates Vulco Rope—gives you the money-saving "concave side" feature. Write for details. The Gates Rubber Company.

71—See page 131. Multi-V-Drives: Advertisement describes 5 features to look for when buying V-belt drives. Write for Bulletin No. V1400B7F for full details on Worthington Multi-V-Drives and QD Sheaves. Send coupon today. Worthington Pump and Machinery Corporation.

PUMPS

72—See page 108. Unipumps: For quick solutions to your pumping problems—application, installation, or replacement, write Weinman today. The Weinman Pump Mfg. Co.

73—See page 137. POWR-SAVR Pumps: Write for Data Sheet 65—gives full details on how "POWR-SAVR" pumps will give you improved efficiency at lower operating costs. Write today. The Aldrich Pump Company.

REFRACTORIES

74—See page 132. Boiler Seam Protector: Free bulletin describes this protector that stops warpage and oxidation of lapped edges; averts leaking, calking, patching. Write today. National Boiler Protector Co.

75—See page 21. Refractory Products: Write for full details on B & W firebrick, castables, mortars, plastics, insulating firebrick. Let Babcock & Wilcox solve your refratory problems. Babcock & Wilcox Co., Refractories Division.

76—See page 142. Refractory Cement: Bulletin describes Super #3000 Refractory that protects inside insulation of metal ducts, flues and breechings with maximum efficiency. Write today. Refractory & Insulation Corp.

REGULATORS AND CONTROLS

77—See page 143. Temperature Control: Leslie Class T and Class M temperature regulators with calibrated dial are time-saving, safe, rugged and simply constructed. Write for descriptive bulletin No. 4648. Leslie Co.

78—**See page 7. Feed Water Control:** Send for Bulletins S-27 and S-20 for complete details on "Swartwout Impulse Regulation" control systems. The Swartwout Company.

79—**See page 45. Combustion Safeguard:** Fireye provides continuous monitoring of oil or gas flame, programming control for automatic ignition systems, boiler water level control and low level safeguard. Write for Bulletin 604-C. Combustion Control Corp.

80—**See page 128. Pressure Regulators:** Write for complete data on Mason-Neilan No. 515 and No. 11 pressure regulators. Ruggedly constructed for long operating life. Mason-Neilan Regulator Co.

81—**See page 63. Pressure and Temperature Control:** Type ED pressure regulators assure accurate, dependable control with maximum money-saving performance. In sizes ¼" to 12" for service with air, steam, water, oil or gas. Write for complete details. Spence Engineering Company Inc.

82—**See page 146. Temperature Regulators:** Write for Stacon Bulletin 50-1000 for full details on extra sensitive, accurate, economical temperature regulators. Farris Stacon Corporation.

83—**See page 31. Regulators and Controls:** Sarco equipment insures increased output at lower costs. For expert help with your controlling and regulator problems, write Sarco today. Sarco Company, Inc.

84—**See page 124. Steam and Water Mixers:** Give you a small, localized supply of warm or hot water. Economical, quickly pay back their cost. Easy installation. Write for free Bulletin 358-S. The Powers Regulator Co.

STEAM TURBINES AND ENGINES

85—**See page 30. Steam Engines:** Engine Bulletin 306 and Governor Bulletin 502 give you complete details on Troy-Engberg steam engines. They provide infinitely variable speeds over extremely wide speed ranges. Write today. Troy Engine & Machine Co.

86—**See page 57. Turbines:** Send for free Bulletin 135. Outlines completely the excellence of Coppus turbines with pilot operated excess speed safety trip. Coppus Engineering Corporation.

87—**See page 60. Special Purpose Turbines:** Many unusual combinations have been developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Write for special purpose turbine information. The Terry Steam Turbine Company.

TOOLS AND SMALL SPECIALTIES

88—**See page 134. Gear and Wheel Pullers:** Catalog contains complete data. 12 types, 40 sizes, 2 and 3 arm plus special models. Check card now for your copy. Armstrong-Bray & Co.

89—**See page 6. Wrenches:** Proto power socket wrenches are available in sizes and designs for almost every type of job. Write for full catalog of Proto tools. Plomb Tool Company.

90—**See page 139. Stocks and Dies:** Ratchet stocks simplify pipe threading where operating room is restricted; adjustable dies start and cut easily, hold sharpness. Write for free catalog. Armstrong Bros. Tool Co.

91—**See page 136. Tube Cleaners:** The new Rotojet removes scale so fast it actually pays for itself in one cleaning. Models available for practically any size tubes. Send for Rotojet Bulletin. Elliott Company—Roto Division.

92—**See page 132. Tube Rolling Control:** You can be sure of maximum tube rolling accuracy, even with inexperienced operators, with this new, improved tube rolling control. Advertisement outlines 8 ways it's better. Write for free information. Airetool Manufacturing Company.

TRAPS, STRAINERS AND SEPARATORS

93—**See page 114. Hoffman Traps:** Be sure to write Hoffman for full data on float and thermostatic traps, radiator traps, inverted bucket traps, dirt strainers and supply valves. Hoffman Specialties insure long term low operating cost. Hoffman Specialty Company.

94—**See page 2. Steam Trap Handbook:** Tables, charts, diagrams and rules for selecting traps make Armstrong's latest booklet a handy reference volume for every engineer's library. Write today. Armstrong Machine Works.

95—**See page 151. Steam Plant Equipment:** Write for Bulletins WG-1823, B-424, T-1739, S-203—complete information on Yarway steam plant equipment. Yarnall-Waring Company.

96—**See page 126. Steam Traps:** Catalog 250 gives full details of Nicholson traps. Bulletin 650 outlines high-pressure floats. Write today. W. H. Nicholson & Co.

Use these postage-free cards to order booklets and catalogs from advertisers, new bulletins and new equipment literature. List key numbers or letters of the paragraphs describing the items you want in the spaces provided on cards.

To: INDUSTRY AND POWER, St. Joseph, Michigan **November, 1950**

Please have forwarded to me, at no obligation, the literature I've indicated by the following Key Numbers and Letters:

Advertised Products Numbers begins Page 110	*New Equipment Numbers begins Page 8*	*New Bulletin Letters begins Page 22*

Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

City_____ **State**_____

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L.&R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

2¢—POSTAGE WILL BE PAID BY

INDUSTRY and POWER
MAUJER PUBLISHING CO.
ST. JOSEPH, MICH.

readers' guide to advertised products

VALVES

97—See page 55. Steel Valves: If you need gate, globe, angle, or check valves this company can provide you with an unusually wide variety for almost every engineering requirement. The Chapman Valve Mfg. Co.

98—See page 48. Brass Pressure Regulator: Crane No. 960 brass pressure regulator insures low cost maintenance—all wearing parts renewable. Virtually never wears out. Write for details. Crane Co.

99—See page 139. Regulating Valves: A new bulletin gives you data on this new Rockwell valve for straight line proportional flow—minimizes pressure drop and turbulence, eliminates clogging. Write today. W. S. Rockwell Company.

100—See page 143. Plug Valves: Visit DeZurik's exhibit at the National Power Exposition; write for complete catalog of revolutionary rubber-plug valves. DeZurik Shower Co.

101—See page 102. Steel Valves: For complete steel valve data, write today. Lunkenheimer steel valves have outstanding records of safety and long service due to metal quality and careful workmanship. The Lunkenheimer Co.

102—See page 9. U-Bolt Valves: Easy to clean, ruggedly constructed, U-Bolt Gates have 16 advanced features that insure wear resistance and easy maintenance. Write for full details in Form 179-B. Jenkins Bros.

Use these postage-free cards to order booklets and catalogs from advertisers, new bulletins and new equipment literature. List key numbers or letters of the paragraphs describing the items you want in the spaces provided on cards.

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L.&R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

2¢—POSTAGE WILL BE PAID BY

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MAUJER PUBLISHING CO.

ST. JOSEPH, MICH.

To: INDUSTRY AND POWER, St. Joseph, Michigan **November, 1950**

Please have forwarded to me, at no obligation, the literature I've indicated by the following Key Numbers and Letters:

Advertised Products Numbers begins Page 110	*New Equipment Numbers begins Page 8*	*New Bulletin Letters begins Page 22*

Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

City_____ **State**_____

103—See page 3. Valves: Be sure to visit Foster at 19th annual Power Show. Display will include Foster Automatic, and 38-SV Valves, Foster Flow Tubes. Write, too, for complete set of illustrated bulletins. Foster Engineering Co.

WATER TREATMENT

104—See page 126. Water Treatment: Write for detailed information about solving your water treatment problems. This complete service includes each step from original survey of problem to installation of water purification equipment. General Filter Co.

105—See page 11. Nalco Water Treatment: Send today for Bulletin 49. Tells you how Nalco system will keep your self-contained boilers operating at peak efficiency without costly difficulties caused by scale and corrosion. Bulletin 46 covers Nalco SR-155 fuel oil additive. National Aluminate Corporation.

106—See page 115. Water Treatment Service: Send coupon for the "Dearborn Plan for Packaged Boilers" outlining full details on water treatment service for packaged boilers. Dearborn Chemical Company.

107—See page 144. Versene Test Kit: Lets you test the hardness of water in your plant in less than two minutes. Includes enough chemical to make more than 50 separate tests. Refills available. Full directions in each kit. Write today. Bersworth Chemical Company.

108—See page 143. Water Treating Equipment: Get your copy of fact-filled bulletins giving complete data on manual or automatic equipment in all sizes, types and capacities. Hungerford & Terry, Inc.

109—See page 25. Cuno Flo-Klean Filter: Makes raw water suitable for many plant services, keeps recirculated water clean, pays for itself in quick time. Write today or send coupon for full information. Cuno Engineering Corporation.

110—See page 128. Santobrite Algaecide: Maintains cooling tower efficiency by preventing sluggishness and obstructions in the circulating system. No special equipment is required. Send for Bulletin 0-15. Monsanto Chemical Company.

111—See page 125. Sphericone: New Graver Sphericone insures clearest softened water, most efficient use of materials and space, uniform stress distribution. Write for complete data. Graver Water Conditioning Co.

WELDING EQUIPMENT

112—See page 56. Oxweld Rods: You'll get faster, easier, better welds with less rod per weld with Oxweld Rods. Write for details. The Linde Air Products Company.

MISCELLANEOUS

113—See page 142. Check This Economy Move: Over 1900 firms supply more than 33,000 products which Hajoca stocks for industry. Use this one source and eliminate your high cost of dealing with many sources of supply for the industrial products you use. Hajoca Corp.

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HOW MUCH CAN YOU SAVE

BY INSTALLING A STEAM-PAK GENERATOR

$20,000.00
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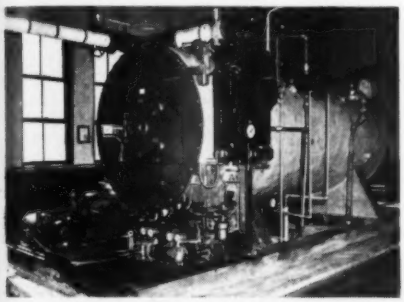
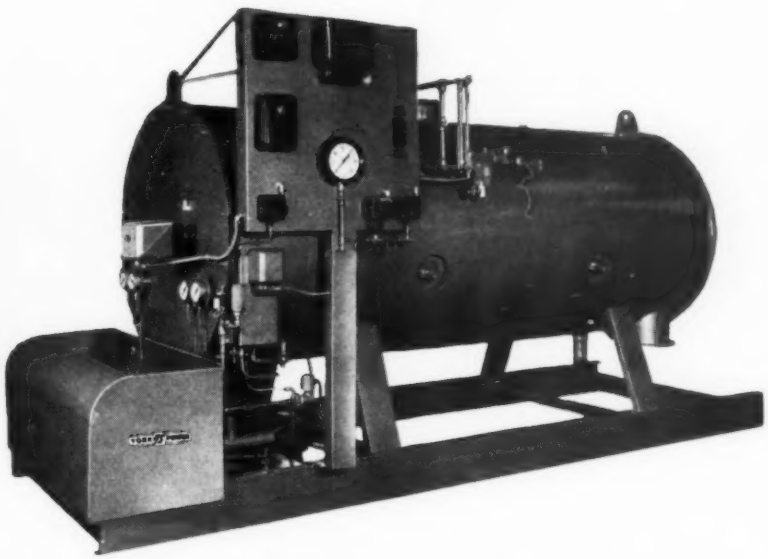
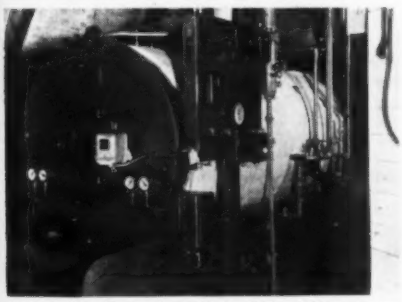


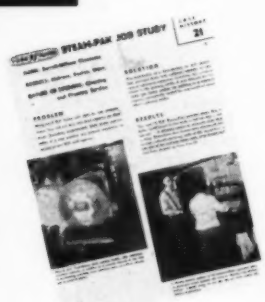
Textile Mill in New England formerly used 40 tons of coal at $13.00 per ton; now uses 5,000 gal. of oil per week at 5¢ per gal.—saving $270.00 per week on fuel cost plus saving salaries of three men. Total saving approximately $20,000.00 per year.



$4,000.00
SAVED ANNUALLY



Dairy in New England purchasing 75 h.p. high pressure York-Shipley Steam-Pak, reduced cost approximately $12.00 per day, including cost of coal, fireman and maintenance.



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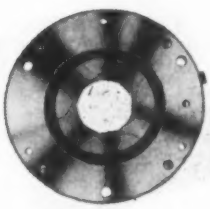
CASE HISTORIES ON HOW OTHERS HAVE SAVED MONEY WITH STEAM-PAK

THE ONLY STEAM GENERATOR with

Iris Shutter

Watch Dog of your Boiler Efficiency



Whether you use gas or oil, absolute control of the air injected into your burner to provide proper flame control is the most important factor toward efficient operation of any steam generator. The famous Iris Shutter, Watch Dog of Efficiency, actually meters the air volume, synchronizing air and oil or gas adjustment from partial load to full load to provide proper flame control.

Steam-Pak Generators are built in capacities from 15 H.P. up, for low or high pressure, steam or hot water, for light or heavy oil, combination gas and oil, or straight gas.

Can you save money with a Steam-Pak? There is one way to find out . . . ask a Qualified Heating Engineer. Your York-Shipley Distributors are thoroughly qualified to analyze your problem and determine savings. See your nearest York-Shipley Distributor or write, wire or 'phone

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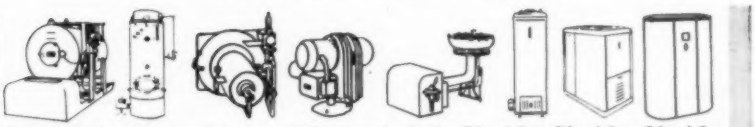

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Have you a problem with

SLUDGE

in your fuel oil system?

READ THIS

"By the use of Houghto-Solv in our Bunker C Fuel Oil we have eliminated the former need for daily shut-downs to remove carbonized burner cups and clean strainer baskets.

"We have found that sludge in storage tanks, which formerly built up to 6" deep, has been completely dissolved. This alone has meant a big saving in labor; it has made the dirty and disagreeable job of hand cleaning, which was never complete nor satisfactory, now unnecessary.

"Altogether, I have found that HOUGHTO-SOLV will do all that has been claimed for it, with more than satisfactory results."

Many similar letters, all reporting immediate efficiency and economy, tell us that Houghto-Solv really does its job! This fast acting fuel oil additive cleans the entire fuel system. It dissolves sludge, making it burnable with the oil. Expensive and messy cleaning jobs are eliminated . . . one application, for example, saved a user nearly $2,000 on tank cleaning.

Results like those in the above letter can be yours, too . . . just add one quart of Houghto-Solv for every 1,000 gallons of oil in your tank. Your sludge problem will be cleared up fast.

Here's all the data—free

This helpful folder completely describes Houghto-Solv. Use the coupon below to get your copy—no obligation, of course.

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Please send me the free HOUGHTO-SOLV folder.

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MEETINGS and EXHIBITIONS

Highlights of coming meetings that will aid executives and engineers in planning itineraries. For additional information, please write sponsors of meetings

NOVEMBER

American Petroleum Institute—The 30th Annual Meeting will be held in Los Angeles, Calif., November 13 through 16. The Biltmore and Ambassador hotels will be used for committee and group sessions and the Biltmore theatre, adjacent to the hotel will be the scene of the general sessions. Write the American Petroleum Institute, Department of Information, 50 West 50th St., New York 20, N. Y. for further information or reservations.

National Power Exposition and ASME Meeting—The 19th National Exposition of Power and Mechanical Engineering will be held in Grand Central Palace, New York, November 27th to December 2nd under the auspices of the ASME in conjunction with the Society's annual meeting.

Complete information may be secured from Charles F. Roth, Grand Central Palace, New York 17, N. Y.

JANUARY

Plant Maintenance Show—and concurrent conference on maintenance techniques will be held in Cleveland, January 15 to 18. Clapp & Poliak, Inc., 341 Madison Ave., New York City 17.

Heating and Ventilating Exposition—The Tenth International Heating and Ventilating Exposition, also known as the Air Conditioning Exposition, will be held at the Commercial Museum in Philadelphia, Pa., January 22 to 26, 1951. The display will be under the auspices of the ASH&VE whose 57th annual meeting will coincide with the exposition. The exposition is under the management of the International Exposition Company, 480 Lexington Ave., New York, Charles F. Roth manager.

FEBRUARY

Industrial Waste Conference—The program for this sixth annual conference, to be held at Purdue University on February 21, 22, and 23, 1951, will cover developments in waste disposal and utilization. Reservations should be made in advance of the conference. Further information may be obtained by writing Don E. Bloodgood, chairman, Purdue Industrial Waste Conference, Purdue University, Lafayette, Indiana.

REVIEWS of RECENT BOOKS . . .

The latest books, read by the Plant Engineering Group, are reviewed here for your convenience. Write directly to the publisher for those in which you are interested

Refractories

"Modern Refractory Practice," third edition, published by Harbison-Walker Refractories Co., Pittsburgh, Pa. Illustrated. 440 pages. Offered without charge to users of refractories, libraries and heads of departments in universities and technical schools. Use your organization letterhead.

A practical engineering handbook containing comprehensive technical information on refractories including descriptions of the company's products. While it follows the general lines of the second edition, published in 1937, the book has been completely rewritten.

Scale drawings of twenty types of furnaces, illustrating up-to-date industrial practice, constitute one of the most important features of the volume. These were prepared with the assistance and cooperation of various engineers who specialize in furnace design. The drawings show in detail, not only the design of the furnaces, but also the types of refractories generally used, and, in some cases they show also alternate types for special conditions and requirements of operations.

A chapter is devoted to suggestions of a practical nature regarding the selection, care and use of refractories, including handling, installation, and service factors which affect their life. Another chapter contains a discussion of arch construction and design, placement of skewbacks, calculation of arch stresses and design of high rise arches.

The chapter on the properties of refractories consists of two parts: The first is devoted largely to the mineralogy of refractories, and to stability relations at high temperatures. Second part pertains to the physical and chemical properties with special reference to those which have greatest significance with regard to the utility of refractories. This chapter contains considerable material not previously published and can serve as a text in technical schools.

Insulation

"Heat Insulation," by Gordon B. Wilkes, Professor of Heat Engineering, Massachusetts Institute of Technology, published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Illustrated. 240 pages. $4.00.

Designed to bring together some of the miscellaneous information on heat insulation in one volume, this book is concerned primarily with the principles of insulation and with the heat

transfer properties of heating materials. It starts with a review of the essential concepts and problems of heat insulation. Professor Wilkes has been connected with the development and application of equipment to determine the effectiveness of heat insulation at Massachusetts Institute of Technology, and one chapter is devoted to a brief discussion of the various types of test equipment, some of which have never before been publicized.

There is a section on air pressure and another chapter deals with the different types of insulating materials. The information on reflective insulation, based on work carried out in the Heat Measurements Laboratory at MIT, plus the data on emissivity, in Table 3 of the appendix, constitutes the first complete treatment of this subject. The economy of insulation, covering house insulation as well as commercial, is treated in the concluding chapter.

Economy

"Principles of Engineering Economy," third edition, by E. L. Grant. Published by The Ronald Press Co., 15 East 26th Street, New York 10, N. Y. 623 pages. Illustrated. $5.00

More than two-thirds of this book has been rewritten, and as in the earlier editions it answers the technical question of "will it pay?" Economy studies of price charges are presented at length along with the theoretical aspects of replacement economy. The reading matter has been improved through a more decided presentation of fundamental principles. Emphasis is placed on two important factors; prospective differences between alternatives that are relevant in their comparison and the fundamental question regarding a proposed investment in capital goods.

Numerous examples are included, and each is listed in the table of contents. The information contained in the book is cross-referenced, and answers to economic problems can be found readily.

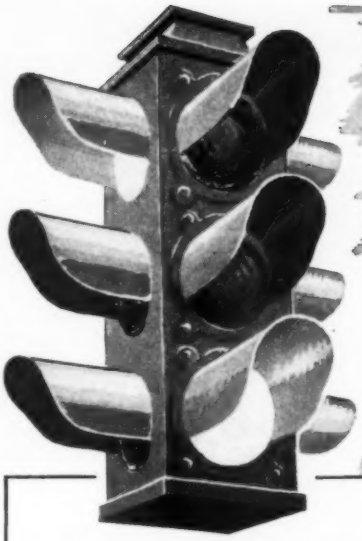
This book is divided into four sections: Part 1—planning economy studies to solve engineering problems; Part 2—interest, the time element in economy; Part 3—techniques for economy studies and Part 4—getting results from economy studies.

Management

"Industrial Organization and Management," Second Edition, by L. L. Bethel, F. S. Atwater, G. H. E. Smith and H. A. Stackman, Jr. Published by McGraw-Hill Book Co. 330 West 42nd Street, New York 18, N. Y. 851 pages. Illustrated. $5.50

The second edition on industrial organization and arrangement is an accumulation of experiences by the authors. Production engineering, economics, industrial relations and administration are treated comprehensively. The primary purpose of the text is to develop an understanding and appreciation of small or large industrial activities.

Material in this book is divided into four logical sections. The first comprises American industry and contains the fundamental concepts, industrial history and basic industry structures. Section two covers industrial organiza-



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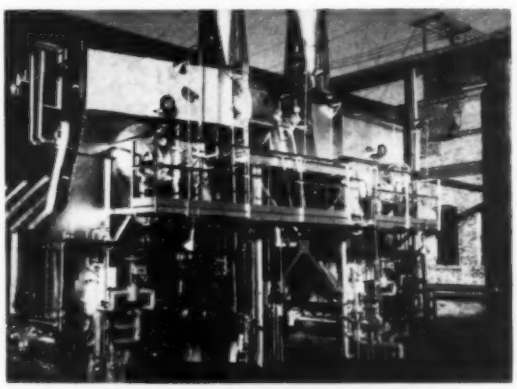
Packaged Boilers Deserve Good Fans, Too!

The same engineering talents and the same careful construction go into the many stack supporting draft fans we have designed for the so-called "packaged" boilers. In some ways, engineering faces more difficult design problems because of the utmost efficiency required in a relatively small space.

Green Stack Supporting Draft Fans are practical, too. They are readily accessible for inspection and maintenance. Shafts and wheels are removable endwise without disturbing the stack or other structural members.

To those manufacturing "packaged boilers" or to those operating them with fans that don't seem to be doing the proper kind of a job or where maintenance seems too high, we offer the services of our experienced fan engineers to (1) design fans suitable for the boiler or (2) study the problem and recommend the remedy.



Our New Bulletin 168 gives details of our Stack Supporting Draft Fans. Write for a copy.

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Wherever you handle liquids, vapors or gases through flexible lines, this engineered combination saves you time and money. CHIKSAN Engineers will gladly assist you in designing flexible lines for the safe handling of a wide range of products...in any length...any size...any pressure to 15,000 psi.

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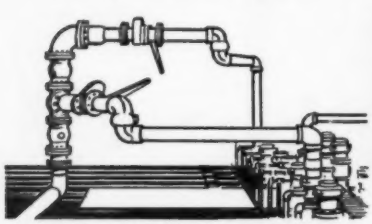
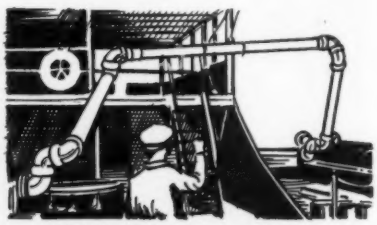
Play safe *all the way!* Use CHIKSAN *Ball-Bearing* Swivel Joints to make up your loading and unloading lines. With them, you get unlimited flexibility with the strength, long life and safety of steel. You get greater protection...greater safety ...and greater economy with CHIKSAN.



Transfer lines using CHIKSAN *Ball-Bearing* Swivel Joints save cost of extra valves and fittings...eliminate contamination losses.



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tion of the enterprise, development of the product through research, improvement of products, standardization and improved plant equipment and layout. Section three pertains to the operation of the enterprise while section four gives information on coordination of all plant activities.

Electricity

"Industrial High Frequency Electric Power," by E. May, Chief Electrical Engineer, Birlec Ltd., John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Illustrated. 356 pages. $5.00.

For the reader who is interested in applying high frequency heating to industrial problems, this book provides an introduction. From basic circuit theory, the text proceeds to operating problems giving a concise summation of basic facts in this growing field. It is designed to give inexperienced people in industry a source of facts and instruction on how these facts can be used as a guide to specific heating problems.

There is an excellent summation of ac theory involved in tuned and coupled circuits as encountered in high frequency heating work and a brief discussion of the arc and spark oscillators. The presentation of high frequency alternators gives a good working knowledge of the problems involved in designing such equipment. The triode tube is discussed in one chapter and another takes in Class B and C amplifiers.

The section on induction heating provides a theoretical presentation plus practical applications. There are also discussions of dielectric heating and auxiliary equipment and high frequency measurements. The final chapter presents the practical approach to industrial uses and operating problems.

Gasification

"Gas Producers and Blast Furnaces, Theory and Methods of Calculation," by Wilhelm Gumz, Consultant, Battelle Memorial Institute, published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 316 pages. $7.00.

Although many reports have been published covering the technical development and experimental results of gasification processes, little attention heretofore has been paid to the development of theory and calculation methods. This book was written to meet the need for this kind of information. It is extremely interesting and often surprising to realize how many blast furnace problems can be solved by calculation.

The author has produced a unique straightforward calculation method for blast furnaces. Starting with a list of symbols and abbreviations, Mr. Gumz develops the theory of gas formation from its fundamental equations, offering several solutions for the mathematical treatment of the problems. Quite a number of practical cases are chosen and presented numerically not only to prove the generally close agreement of calculation and measurement but also to display the general applicability of the methods discussed and to cover the whole field of gas producer and blast furnace practice as far as it can be subjected to calculation.

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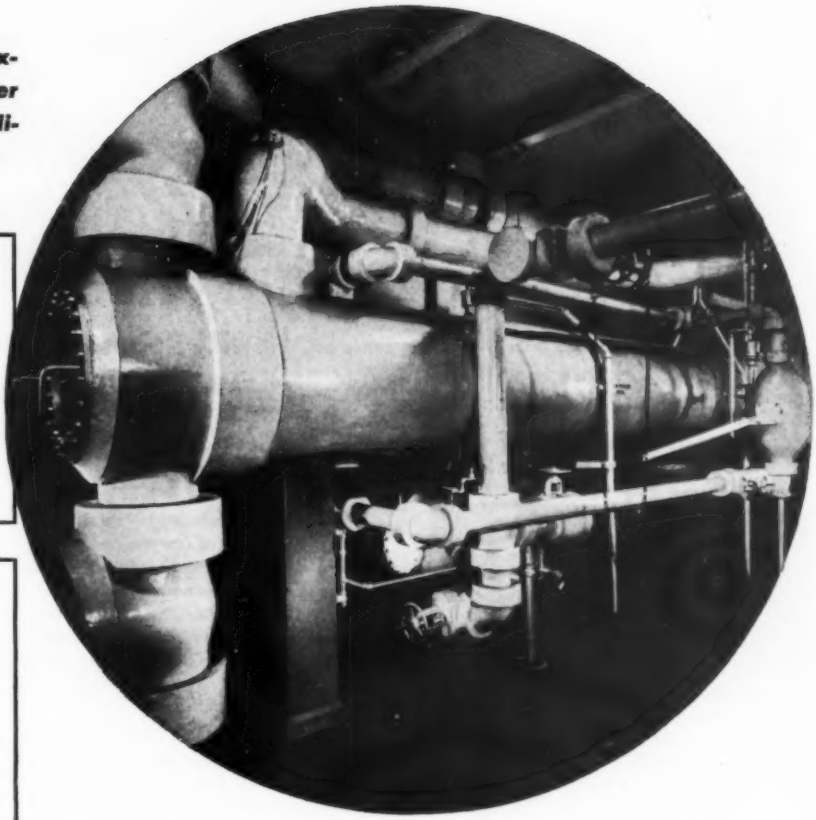
3 Factors

for best results in feedwater heating

Here's why you can be SURE of exactly the right feedwater heater for your particular plant conditions when you consult G-R.



1

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EFFECTIVE DESIGN DETAILS... breech-block head for high pressure . . . pass partition sealing plates for prevention of leakage between passes . . . special baffles for steam guidance and prevention of tube erosion . . . special air and drain baffles for improving thermal efficiency.

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60 YEARS OF EXPERIENCE in designing and building feedwater heaters . . . many hundreds of units in stationary and marine service.

This brief outline of G-R Feedwater Heaters is explained in detail in Bulletin 279, which graphically describes the many important features that are obtainable only in G-R designs. If you will write us your requirements, a copy of this informative bulletin, together with recommendations for your particular plant requirements, will be sent without obligation.

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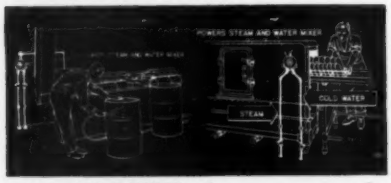
ECONOMICAL—Quickly pay back their cost. Thousands now in use. *Easy to Install.* Requires steam and water pressures above 10 lbs. Steam is mixed directly with water.

MANY USES—Industrial processes; 180° F. sterilizing rinse water for dishwashers; washing oil drums, trucks, etc.



TEMPERATURE RANGE—Any temperature desired between that of incoming water and 200° F.

HAS PRESSURE EQUALIZING VALVE—which prevents delivery temperature changes caused by fluctuating pressures of steam or water.

SMALL SIZE—½" pipe size can be held in the palm of the hand, has 5" dial; ¾" size has 7" diam. dial.

CAPACITIES—based on steam and water at 45 lbs. pressure each, water at 60° F., and delivery temperature of 160° F.:—½" size =3 gals. per min.; ¾" size=8 gpm. Mixing steam with 140° F. water increases delivery about 75%. Often used as a small booster heater. ***WRITE for Bulletin 358-S***

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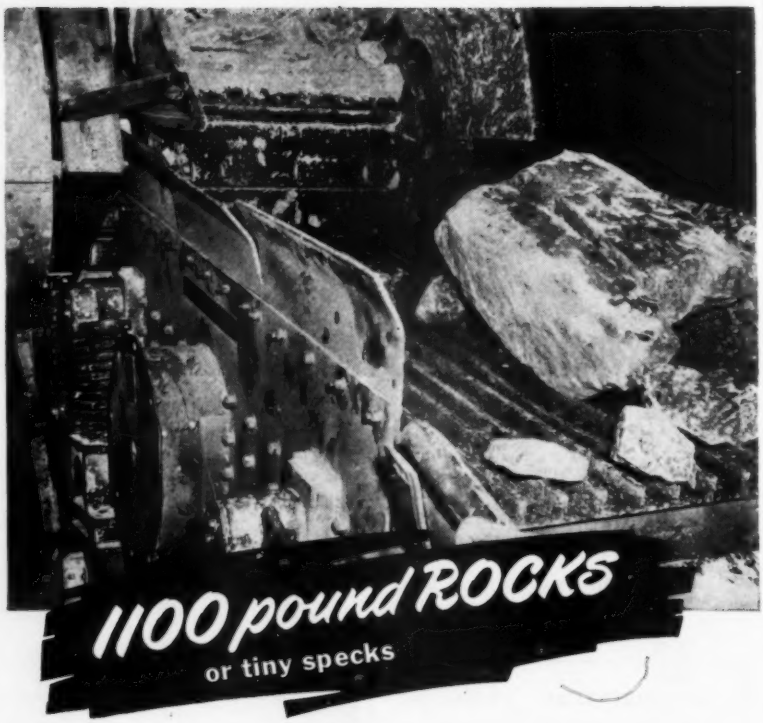

. . . Hewitt-Robins Vibrating Screens Process Them All!

Take a look at that big brute of a machine. It's a vibrating screen—a Hewitt-Robins Heavy Duty Scalper.

The big rock you see on its deck is a 3 x 2 x 1½ lump of ore weighing about 1100 pounds. The Scalper handles loads like this at 1000 tons an hour. Yet, it absorbs those loads—and its own vibration—so completely that a coin placed on edge on the base beams will stand up without toppling over *while the machine is running!*

The same company that makes this big brute also makes a small screen called a Ceramic Slip Lawn. This lawn is so precise in action, so effective in operation, that it finds and removes tiny specks of impurities—about ½ pound in every ton of material—from clay slip for pottery plants.

Think of that range—from 1100 lb. rocks to tiny specks! It's the best proof of all that Hewitt-Robins can satisfy *your* vibrating screen demands!

Just look at these facts: Hewitt-Robins originated the circle-throw principle for vibrating screens. Hewitt-Robins created the elliptical throw. Hewitt-Robins pioneered in both 4-bearing and 2-bearing vibrators. Hewitt-Robins introduced the full-floating principle of vibration-absorption.

Whatever you want in vibrating screen equipment, you can *safely* rely on Hewitt-Robins. Tell us your needs; we will supply the answer. Write to Robins Conveyors Division, 270 Passaic Avenue, Passaic, N. J.

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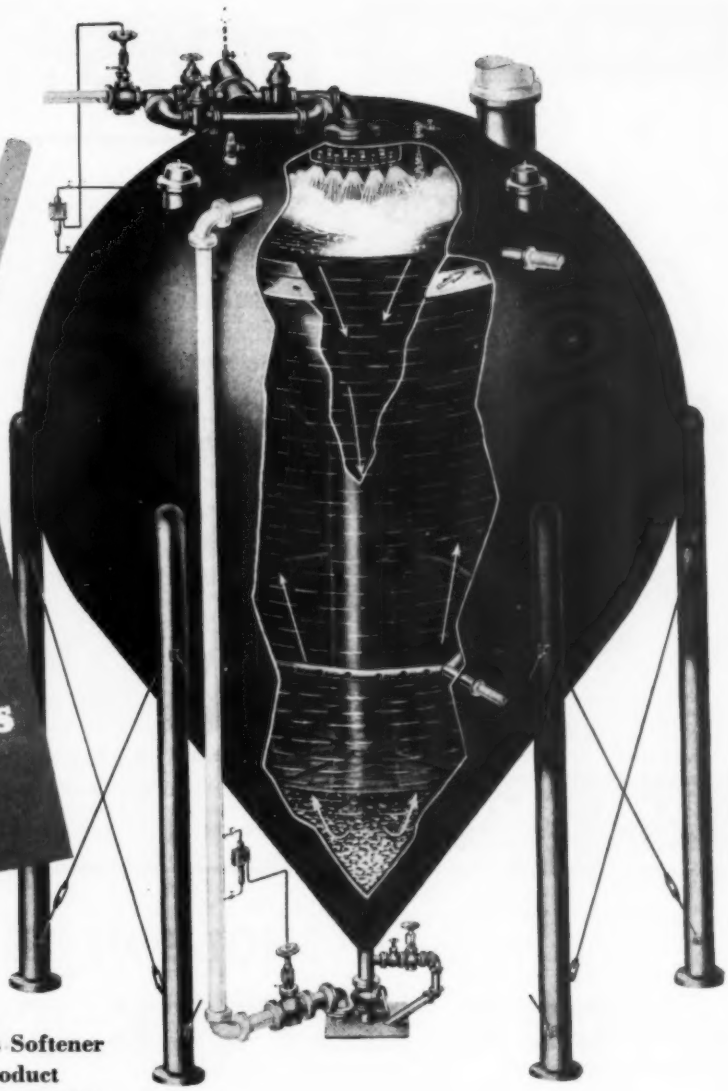
GRAVER SPHERICONE for Hot Process Softening . . .



An improved design for Hot Process Softener Sedimentation Tanks . . . another product made possible by Graver's unique combination of chemical engineering skill and tank fabrication experience. • The new Graver Sphericone has many functional and structural advantages over other designs of hot process softener sedimentation tanks:

❶ ***Clearest softened water*** **. . . because the expanding settling zone provides maximum settling area and lowest rising rates. This assures minimum load on filters . . . saves operator's time and filter media replacement.**

❷ ***Most efficient use of materials and space*** **. . . because of the exclusive Sphericone shape.**

❸ ***Uniform stress distribution*** **. . . because of the virtual elimination of knuckle radii.**

GRAVER

The new Sphericone is made in Graver's own shops, together with all the other major component parts of the Graver Hot Process Softener. Write today for complete data.

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Division of Graver Tank & Mfg. Co., Inc.

GW 431

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NEWS . . . of men and companies

D. J. Murray Manufacturing Co.—The Chicago office is now located at 612 North Michigan Ave., in the Michigan-Ohio building. The office was formerly in the first National Bank building. O. J. Malina, sales manager of the Unit Heater division is in charge.

Hammel-Dahl Co.—John O. Tragard and Maurice MacDonald have recently been named vice-presidents. Mr. Tragard, appointed v-p in charge of sales and contracts, was with the Foxboro Co. for 20 years as sales executive and

M. MacDonald

J. O. Tragard

legal counsel. Mr. MacDonald who will also be manager of engineering, was chief engineer in charge of instrumentation and control at the M. W. Kellogg Co. The office of Scientific Research and Development of the United States has cited Mr. MacDonald for his pioneering work in development of oxygen plants during World War II.

General Power Plant Corp.—Two new sales representatives are: Spurgeon Co., 23501 Hoover Road, Van Dyke, Mich., for the lower Michigan peninsula; and Stephen Co., 7016 Euclid Ave., Cleveland, Ohio, in Ohio.

BullDog Electric Products Co.—New production facilities have been added in Bellefontaine, Ohio. The newly acquired plant of 26,000 sq ft will operate under the name "Bellefontaine Electric Products Co". Named to head the new division are: Walter R. Turner, president; Joseph H. Fribley, vice-president; Karl K. Kahler, secretary; John R. Hornung, treasurer; William H. Frank, Jesse J. Mitchell and Walter R. Turner, directors. Charles Zimmel, production superintendent, will be in charge of the new plant. At present only Pushmatics will be produced.

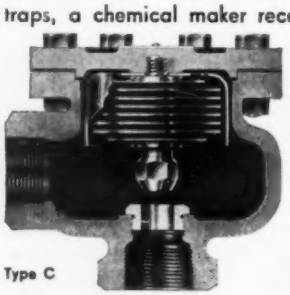
Chiksan Co.—Sales headquarters for the Rocky Mountain area have been established in Salt Lake City with B.

NICHOLSON TRAPS

CUT KETTLE TIME 48%

FOR LARGE PROCESSOR

By substituting Nicholson thermostatic steam traps, a chemical maker recently reduced the heating cycles of cookers from 1¾ hrs. to 50-60 min., a gratifying speed-up of 48%. Reasons for Nicholson's faster heat transfer: operate on lowest temperature differential; 2 to 6 times average drainage capacity; maximum air venting.



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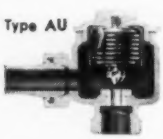

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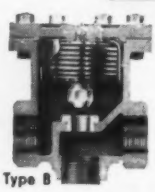

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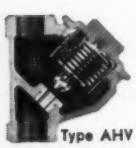

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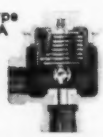


Type A

5 TYPES FOR EVERY PURPOSE — process, heat, power; size ¼" to 2"; pressures to 225 lbs.

Catalog 250 or see Sweet's

HIGH-PRESSURE FLOATS — Stainless, monel, plated steel. Welded. All sizes and shapes; for operating mechanisms and as vessels. 2-day delivery. BULLETIN 650.

W. H. NICHOLSON & CO.

135 OREGON ST., WILKES-BARRE, PA.

Representatives, in 53 Principal Cities, to Help You Solve Specification and Maintenance Problems in Traps, Floats, Control Valves

P. Ragsdale in charge. Formerly a member of Chiksan's engineering department, service representative, and sales engineer in the Southern California territory, Mr. Ragsdale will handle sales and service on Chiksan, WECO, Anchor and Okadee products. The Rocky Mountain headquarters were formerly in Denver, with Al Myers as sales representative. Mr. Myers has resigned to enter business for himself.

Edward Valves, Inc.—Laurence H. Carr has been named director of engineering and research. He has been a member of the technical staff since 1938 and was previously chief metallurgist. In his new position, he will be responsible for consolidating the development functions of engineering research, product engineering and techological specifications for process control.

Ralph A. Mumert is the new sales engineer with F. J. Hearty & Co. of Los Angeles and San Francisco, west coast representatives for Edwards.

Carl W. Nedderman has been elected assistant v-p of Edward Valves. Mr. Nedderman joined the company in 1948. In his new position he will be responsible for budgets, financial and accounting, and cost department operations.

Department of the Interior—C. B. McManus, president of the Georgia Power Co., Atlanta, and Richard K. Lane, president of the Public Service Co. of Oklahoma, Tulsa, have been named as consultants to this department. They will advise Secretary Oscar L. Chapman in carrying out the responsibilities in the field of electric power delegated to him under the executive order issued by the President on September 9, pursuant to the defense production act of 1950.

Yale & Towne Manufacturing Co.—The retirement of Ellis H. Jones as general manager of the Canadian Div., after 57 years of service and the appointment of George L. Dirks to succeed him have been announced from the St. Catherine, Ont., Canada office of the company.

F. W. DuBois Co.—J. E. Cooper, formerly supervisor of special and sanitary plant engineering, Ford Motor Co., has resigned to become associated with F. W. (Duke) DuBois in a sales engineering organization to be known as DuBois-Cooper Associates, with offices at 15760 James Couzens Hwy., Detroit 21, Mich.

Electric Storage Battery Co.—This month marked the 25th anniversary of Ernest F. H. Grothe in the company's employ. In recognition of the occasion, he received a watch from S. Wyman Rolph, president of the firm. During his quarter century with the Exide battery manufacturers, Mr. Grothe has been responsible for the development of the vent plug hydrometer syringe and the battery connector puller. He has also written several manuals.

W. H. Brady Co.—W. E. Schneider has been appointed the merchandising manager. He was formerly advertising

(Continued on page 130)

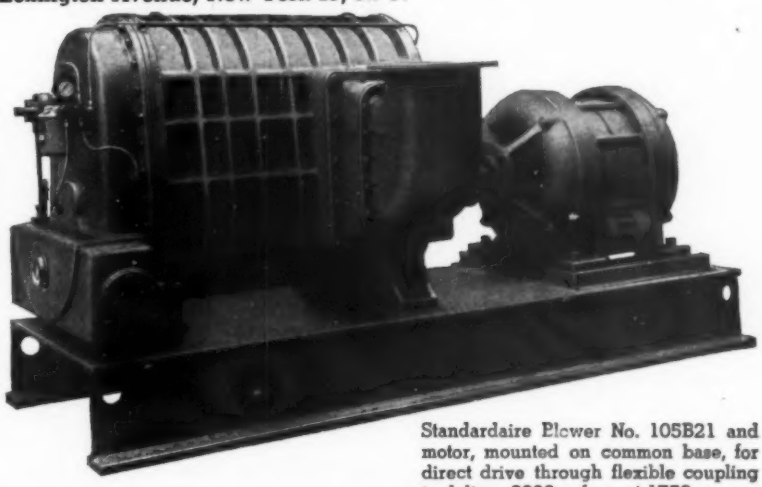
The STANDARDAIRE
PRECISION BUILT
Axial Flow BLOWER

Features Two More Vital Components:

PRECISION ROLLER BEARINGS—spherical type are used on the fixed ends of the rotor shafts and a cylindrical type on the floating ends. With such a design free aligning action of the rotor shafts is assured and specific speed, load, and service requirements are easily met. In addition, this bearing construction fully compensates for any housing distortion which might occur due to temperature differentials.

LABYRINTH TYPE OIL SEALS—Bearings and gears are lubricated by a spray of filtered oil. The oil is controlled by a balanced pressure, labyrinth type seal which gives complete oil control and assures absolutely clean air delivery under all operating conditions.

Such features as precision bearings—frictionless oil seals—hardened, shaved, helical gears—contribute immeasurably to the efficient and dependable performance of the Standardaire Blower—A Modern Machine with Superior Operating Characteristics. For further information write The Standard Stoker Company, Inc. Dept. C-33, 370 Lexington Avenue, New York 17, N. Y.



Standardaire Blower No. 105B21 and motor, mounted on common base, for direct drive through flexible coupling to deliver 3200 c. f. m. at 1750 r. p. m.

THE STANDARD STOKER CO • INC •

Standard Stoker

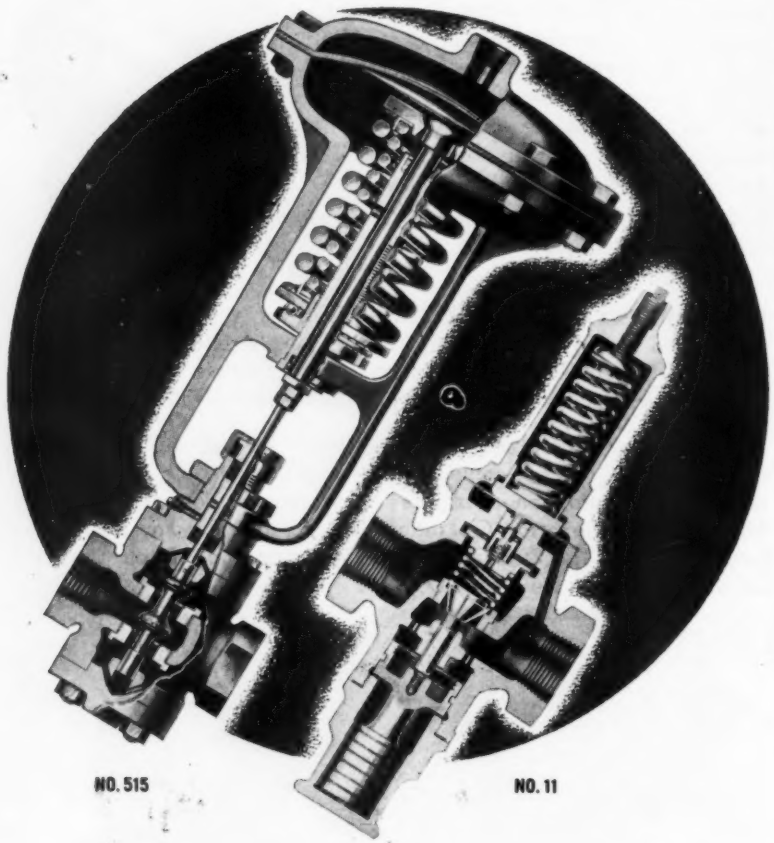
NEW YORK • CHICAGO • ERIE • YORK • MONTREAL

FOR PREFERRED PERFORMANCE

without

Paying Premium Prices . . . Use

Masoneilan Pressure Regulators



NO. 515 NO. 11

You can depend on Masoneilan performance-proved reducing valves and pump pressure regulators to provide accurate control of steam pressures. Constructed of quality materials throughout, these regulators incorporate many cost-cutting features that assure long operating life with little if any maintenance.

No. 11—Initial pressures up to 250 lbs. reduced to any desired pressure between 5 and 75 lbs. or 75 and 225 lbs. Sizes ½" to 2" — bronze; 2½" to 4" — iron.

500 Series — Maximum working pressures from 125 lbs. at 350°F, to 250 lbs. at 450°F; pressure ranges ¾-3; 2-8; 6-25; 20-75; 60-160 lbs. Sizes ½" to 6".

MASON-NEILAN REGULATOR CO.

1191 ADAMS STREET, BOSTON 24, MASS., U.S.A.

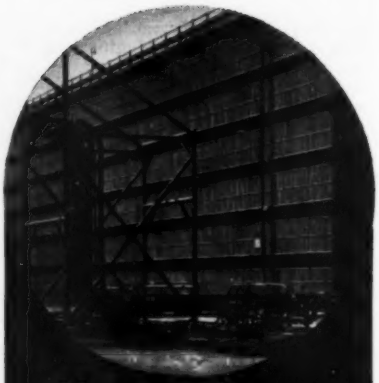
Sales Offices or Distributors in the Following Cities:

New York • Syracuse • Los Angeles
Pittsburgh • Tulsa • Cleveland
San Francisco • Chicago • El Paso
Charlotte, N. C. • Detroit

MASONEILAN

St. Louis • Philadelphia • Houston
Atlanta • Denver • Salt Lake City
Cincinnati • Boise • Albuquerque

Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



Monsanto SANTOBRITE controls slime and algae in cooling towers

Slime and algae, enemies of good cooling tower operation, are kept under control by Santobrite (Monsanto's sodium pentachlorophenate, technical). Santobrite is economical...easy to use...efficient.

If slime and algae cause trouble in your cooling towers, it will pay you to read Monsanto Technical Bulletin No. O-15. For your copy, contact the nearest Monsanto Sales Office or write: MONSANTO CHEMICAL COMPANY, Desk A, 1743 South Second Street, St. Louis 4, Missouri.

Santobrite: Reg. U. S. Pat. Off.

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CHEMICALS for PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

Trustworthy

...in Constancy
...in Value

Wherever an electrical measurement provides essential information... whether in the manufacture of electrical components, the inspection of purchased parts or finished products, or in the operation of some electrical machine... far-sighted buyers specify "meters by WESTON". Experienced buyers know that in value, and in performance, there is no substitute for WESTON instruments. Ask your nearest WESTON representative for all the facts, or write for bulletin A-7-B. WESTON Electrical Instrument Corporation, 637 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON
Panel Instruments

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San Francisco • Seattle • St. Louis • Syracuse • Tulsa • Washington, D. C. • In Canada, Northern Electric Company, Ltd., Powerlite Devices, Ltd.

HERE'S A HEAVY-DUTY HUSKY with a 7½ cubic foot DUST APPETITE!

The New HOFFCO-VAC #50 PORTABLE VACUUM CLEANER

WRITE FOR BULLETIN A-794

★ Improved design, 5 H.P. model operates two 50-foot lines of 1½-inch hose simultaneously, or one 75 or 100-foot length of 2-inch hose.

★ Self-lubricated ball bearings.

★ Spring-mounted vacuum unit.

★ Longer operating period.

★ Easy dust disposal.

For high-capacity, continuous cleaning, the new Hoffco-Vac #50 is the all-purpose, two-sweeper machine! Specifically designed for use where large dust accumulations are to be handled—where non-stop cleaning is necessary—or where superior separation is a requirement. Handles like lighter, smaller machines. Successor to the famous Hoffco-Vac originated in 1939, the new #50 is one of 4 sizes of portables built by Hoffman. Stationary systems available, too, in a wide range of sizes. Write today for literature.

HOFFMAN BUILDS MULTISTAGE CENTRIFUGAL BLOWERS and EXHAUSTERS

All capacities up to 10,000 c.f.m. and various air pressures up to 8 lbs. Low maintenance and power costs. Write for Bulletin A-650.

AIR APPLIANCE DIVISION

U.S. HOFFMAN MACHINERY CORPORATION

100 EAST 12th STREET, NEW YORK 3, N.Y.

CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO., LTD., NEWMARKET, ONT.

(Continued from page 127)

manager of the Prest-O-Lite Battery Co., Inc., a subsidiary of the Electric Auto-Lite Co. of Toledo, Ohio.

Lunkenheimer Co.—Edmund P. Lunken, v-p, also has been elected secretary. Mr. Lunken succeeds Charles W. Burrage, now manager of sales engineering, devoting his full time to sales.

E. P. Lunken

L. A. Swem

Foster Wheeler Corp.—Appointment of Lee Allen Swem as v-p in charge of the newly formed International Div. has been announced. The new division will be responsible for foreign business and will coordinate activities of subsidiaries in Canada, England and France.

DeLaval Steam Turbine Co.—The R. M. Sorlie Co. of Kalamazoo, Mich. is the new sales representative for the western half of the lower peninsula of the state of Michigan. Robert F. Curry has been named to the DeLaval office in Detroit as an expert in the power transmission field.

General Electric Co. has purchased the patents, name and technical data of the Turbodyne Corp. of Hawthorne, Calif., a Northrop Aircraft, Inc. research subsidiary which has developed a turboprop aircraft engine. G. E. participated in the early development of the turboprop engine but has been concentrating its efforts up to this time on the turbojet engines.

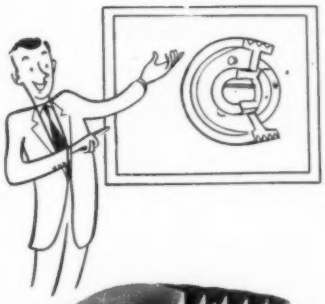
William N. Oberly has been appointed assistant to Lisle D. Hodell, manager of manufacturing of the Fractional Horsepower Motor Div. He will be located at the company's plant in Fort Wayne, Ind. William R. Boggess is the new assistant manager of sales for this division and will also have his headquarters in Fort Wayne.

Dr. James L. Lawson will be manager of the newly formed Electron Physics Div. at the G. E. Research Laboratory. Clifford G. Fick has been named assistant manager. The divisions include the Electron Tube Div. with E. D. McArthur as head, the X-Ray Div. headed by Dr. Ernest E. Charlton, the Nuclear Physics Div. of which Dr. Lawson is head, and the Communications Research Div. under Mr. Fick.

W. C. Harris of Erie, Pa., has been appointed manager of the Locomotive & Car Equipment Divs. of the Apparatus Department. He succeeds H. W. Gouldthorpe, recently appointed manager of the Transportation Div. in

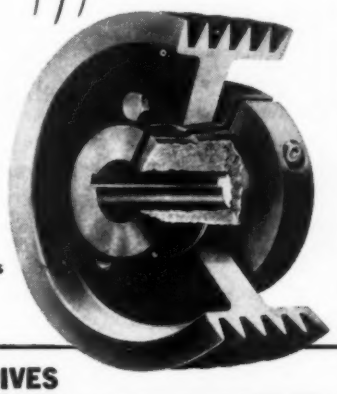
(Continued on page 132)

Don't buy a V-Belt Drive unless–

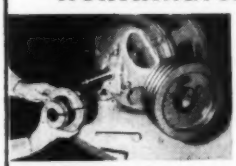


1. the sheave comes in two parts for easy mounting—separately or as one-piece assembly[a]
2. the hub and rim are "taper-mated", for friction cone grip and positive press fit on shaft[b]
3. the clamped hub holds shaft position when rim size is changed—no realignment problem[a]
4. I-beam spokes on driven sheave help carry heavier load with less weight[a]
5. the belt carries the load with minimum internal friction[c]

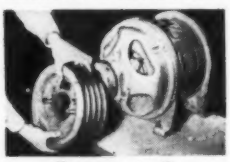
a Worthington exclusive
b Worthington original
c Worthington-Goodyear original—endless load-carrying cords in neutral axis



WORTHINGTON MULTI-V-DRIVES



Easy to get on

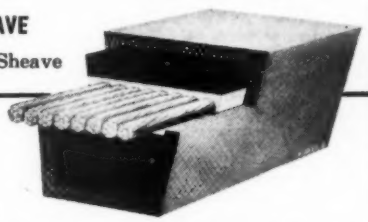


Easy to get off

Yet always tight on the shaft

WORTHINGTON QD SHEAVE

Original Tapered Cone-Grip Sheave



WORTHINGTON-GOODYEAR EC CORD V-BELTS

Each endless cord carries an equal share of the belt load—each belt, matched and uniform in length, carries an equal share of the drive load.

Send coupon for latest Worthington QD Sheave bulletin, V1400B7F

Complete Range of QD Stock Sizes— Prompt Shipment 853 listed stock sizes in "A", "B", "C", and "D" sections fhp to 600 hp... 332 listed stock sizes of EC Cord V-belts.

It was a crisis that occurs only on Saturday mornings

Minutes before noon on a Saturday morning, a frantic call to **Oberjuerge Rubber Distributing Co.**, St. Louis, Mo. reported a motor failure at a brickyard.

A week's stoppage of production was threatened.

A different motor was available, but not the right rpm.

Could Oberjuerge furnish belts and sheaves to give the proper speed? Answer (after some quick calculations): yes—two Worthington QD Sheaves, 8 groove, 16 in. driver, 58 in. driven, with a set of 8 Worthington-Goodyear V-Belts.

By mid-afternoon, the brickyard was back in production. Again, a Worthington distributor had saved the day—or, in this case, a week!

WORTHINGTON

ORIGINATORS OF THE QD SHEAVE
WORTHINGTON PUMP AND MACHINERY CORPORATION
MULTI-V-DRIVE SALES DIVISION
Buffalo, N. Y. · *General Offices:* Harrison, N. J.

The Good Right Hand of Industry

POWER TRANSMISSION: sheaves, V-belts, variable speed drives
PUMPS: centrifugal, power, rotary, steam
AIR COMPRESSORS: water-cooled, air-cooled

Worthington Pump and Machinery Corp.
Multi-V-Drive Sales Division,
Buffalo, New York

Send Bulletin V1400B7F on Worthington Multi-V-Drives.

Name.....
Company.....
Address.....
City.....Zone....State.....

with this New, Improved AIRETOOL Tube Rolling Control

You can save time and cut as many as 8 valuable hours from similar tube rolling jobs with this new AIRETOOL Control. Uncanny tube rolling accuracy is now assured, even with inexperienced operators.

MOBILE UNIT

BETTER these 8 important ways . . .

- The original control calibration is permanent . . . needs no adjustment.
- Relay operation is accurate and free from chatter.
- Employs or needs no delicate electronic tubes.
- No voltage regulator necessary for regular power sources.
- Minimum number of moving parts to wear out.
- Control consumes minimum current . . . delivers maximum power to motor.
- Every Control individually calibrated and shop tested before delivery.
- Designed for field and maintenance shop work as well as for new work. Available as a mobile unit.

BEST in Lab, Shop and Field . . .

Every test proves that the AIRETOOL control is the best obtainable at any price. Cash in on these benefits now. Write the AIRETOOL Manufacturing Co., 318 S. Center St., Springfield, Ohio.

There's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

BRANCH OFFICES: New York, Philadelphia, Chicago, Houston, Tulsa, Baton Rouge

(Continued from page 130)

Schenectady. Also announced was the appointment of R. A. Hutchins assistant to the manager of the Locomotive & Car Equipment Div.

W. C. Harris

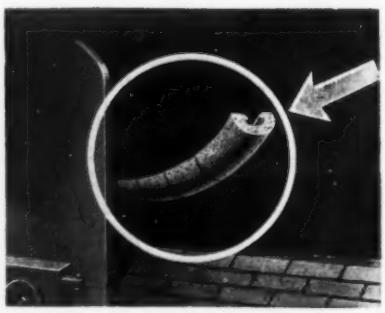
C. H. Myers

National Supply Co.—Corbin H. Myers has been appointed superintendent of industrial engineering at the Torrance, Calif., plant. At the same time the company also announced that David M. Sowle has been made superintendent of industrial relations at Torrance. Mr. Myers joined National Supply in 1947 as an industrial engineer and prior to his recent appointment he was supervisor of the standards department. Mr. Sowle came to the Torrance plant in 1946 as an industrial relations analyst becoming employment manager in 1948.

Sarco Co., Inc.—The retirement of Gus A. Binz, for the past 20 years sales

(Continued on page 134)

Don't say we didn't tell you



If the riveted seam of your HRT boiler lets go and hurts someone, you'll regret you didn't install a National Seam Protector.

The Protector insulates the seam with an arch of refractory tile, thereby stopping warpage and oxidation of lapped edge. This averts leaking, calking, patching.

Delay might be costly and tragic. Write now for complete information.

NATIONAL BOILER PROTECTOR CO.
929 Riebolt Bldg. Dayton 2, Ohio

WHY ALBANY GREASE FOR 82 YEARS?

Have you ever noticed what happens when a piece of tallow is placed in a frying pan and heat is applied? The heat causes the tallow to melt and spread over the surface of the metal, thereby protecting the metal from overheating, warping, excessive expansion and loss of temper. When heat is shut off and the pan cools, the tallow solidifies but still covers the same area that it did when it was liquid, thereby acting as a protective coating against the next application of heat.

ALBANY GREASE gives you this same "TALLOW coverage and protection" in your machinery. No other grease marketed can make this claim.

Have you tried it? It is and has been the ultimate of the grease industry for 82 years.

ALBANY GREASE is a superior product and is not to be compared with ordinary lubricants at any price.

ALBANY GREASE will cut your "down time" and eliminate the worries that go with inefficient lubrication.

Know the difference in greases by writing for your free sample and literature.

ALBANY LUBRICATING COMPOUND

ADAM COOK'S SONS, Inc.
Mfrs. of Albany Lubricating Products
LINDEN, NEW JERSEY

THERE ARE 6 WAYS THAT DRACCO Pneumatic Conveyors SAVE MONEY. THIS INCLUDES LOWER LABOR COSTS

● DRACCO Pneumatic Conveyors make 6 distinct savings in handling chemicals, grains, or granular materials—in most installations LOWER LABOR COST is the important factor. The number of savings made depends upon the material handled and many other factors. Material handling is an every day expense that should be reduced to the MINIMUM. For over 35 years DRACCO Engineers have analyzed hundreds of plants and recommended cheaper and better ways of handling materials. Why not have them check your methods for possible savings —they will be able to find them.

DRACCO
Pneumatic Conveyors
SAVE MONEY

1. Reduce labor cost.
2. No loss of material in handling.
3. No contamination.
4. Eliminates dust.
5. Material received in bulk at lower cost.
6. Low maintenance cost.

Have
DRACCO
Check
YOUR PRESENT METHODS FOR POSSIBLE SAVINGS

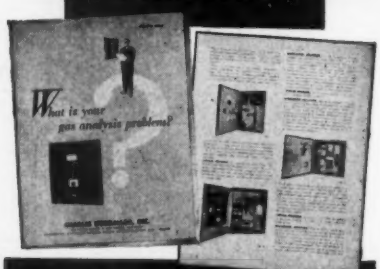
For Further Information Write

DRACCO CORPORATION
4046 E. 116th St., Cleveland 5, Ohio New York Office: 130 W. 42nd St.

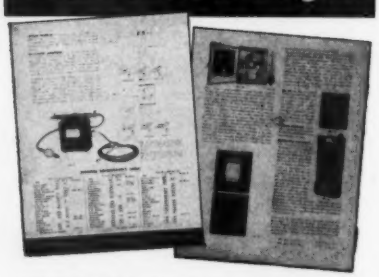
DUST CONTROL EQUIPMENT
PNEUMATIC CONVEYORS • METAL FABRICATION

Want to know more about GAS ANALYSIS?

Read this New 8-page ENGELHARD BULLETIN



Look at these Data • Packed Pages



YOU WILL FIND a wealth of material on a wide range of gas analysis problems and their solutions in the new Engelhard 8-page illustrated bulletin. It explains how Engelhard equipment provides complete, sensitive, accurate analyses by the proven thermal conductivity method. The bulletin also contains a *valuable thermal conductivity table* that you will want to keep for handy reference. *Write for your free copy today. Ask for Bulletin 800A.*

Please send me FREE copy of Bulletin 800-A on Gas Analysis.

Name .....

Company .....

Address .....

City ..... State.....X1234

CHARLES ENGELHARD, INC.
850 PASSAIC AVENUE, EAST NEWARK, N. J.

(Continued from page 132)

promotion manager, becomes effective November first. After that time Mr. Binz will establish himself as an independent advertising agent at 332 Springfield Ave., Summit, N. J.

Gus A. Binz

R. A. Haworth

Cutler-Hammer, Inc.—R. A. Haworth will be the new manager of the Dallas district sales office. He joined the company in 1934 holding several sales positions. Since the opening of the Baltimore sales office in 1936, he has served as its manager.

OBITUARIES

Yale & Towne Manufacturing Co.—Joseph A. Horne, 82, chairman of the board of directors, died October 3, after a brief illness. During his 58 years of uninterrupted association with Yale & Towne, Mr. Horne had become a leading personality in the locks and hardware industries. He started his long identification with the company in 1892 as a foreman, then rose successively to be department superintendent, general superintendent of the Stamford plant, v-p and general superintendent, acting president during World War I, v-p in charge of production, and, since 1943, chairman of the board.

General Electric Co.—Earle S. Henningsen, 60, retiring manager of engineering of the Large Motor and Generator Div., died September 23. A pioneer in the development of alternating-current machinery, Mr. Henningsen was to have retired October 1 after 38 years' service with the company.

Arelin L. Wagoner, 65, who retired as purchasing agent of steel and steel products April 1, died on September 28. He entered the employ of G. E. 43 years ago as a purchasing department clerk.

New York Central Railroad—Albert A. Raymond passed away August 30. He was staff advisor to the operating departments on fuel and locomotive performance. His research work included the application of fuel for economy of operation, better smokeless performance, and an automatic speed and cut-off recorder to check fuel performance. He was a past president of the Railway Fuel and Traveling Engineers Association and a fellow of the American Society of Mechanical Engineers. Mr. Raymond was also a v-p and director of the Air Pollution and Smoke Prevention Association of America and was serving as chairman of the public relations and publication committee.

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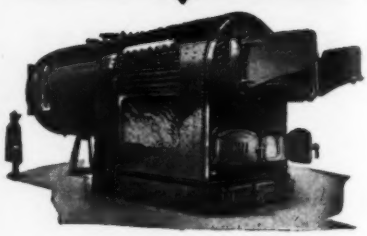

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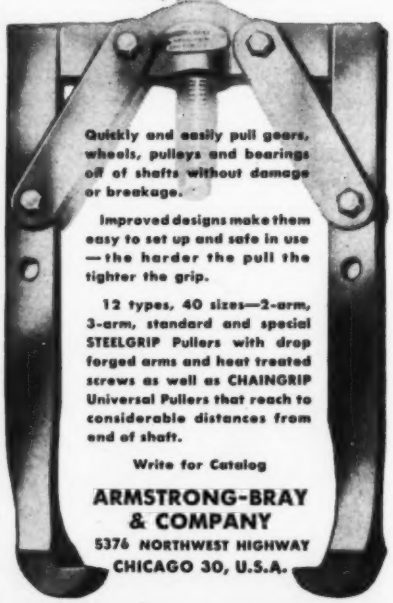
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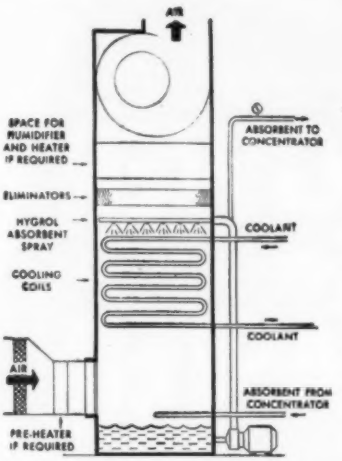
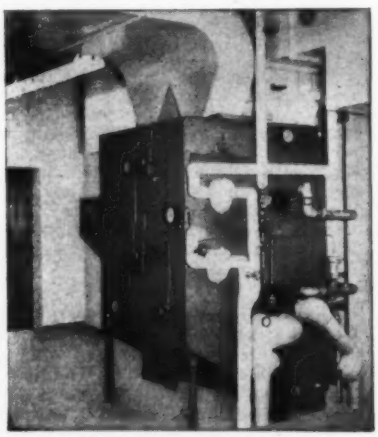
Using "Hygrol" hygienic absorbent liquid, this method gives complete control of temperature and relative humidity. Especially, it is a better way to obtain dry air for drying processes, packaging hygroscopic materials, preventing moisture damage to metals, and obtaining better quality for chemical process products and food products—or in obtaining better results in comfort air conditioning for office or laboratory at lower refrigeration costs.



NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

Food Packaging under Controlled Humidity


Niagara Controlled Humidity Air Conditioner

The diagram shows how filtered air is dehumidified by passing thru a spray of "Hygrol"—a liquid absorbent which removes air-borne moisture. This liquid is hygienic and non-corrosive; it contains no salts or solids to precipitate and cause maintenance troubles. It is continuously re-concentrated at the same rate at which it absorbs moisture, providing always the full capacity of the air conditioner, automatically.

Units provide a range of capacities from 1000 to 20,000 C. F. M. Multiple unit installations are in use successfully. Records of results are available. For further information, write Niagara Blower Co., Dept. IP, 405 Lexington Ave., New York 17, N. Y.

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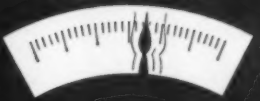

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STABILINE Automatic Voltage Regulators maintain a constant output voltage, regardless of variations in input voltage or load current. They need no attention—are trouble- and maintenance-free over long periods of continuous operation.

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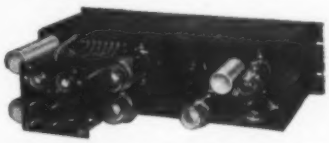

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ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

S-530 ROTOJET Air-driven Motor with swing-frame head for 3¼"-3-13/16" I D straight tubes.

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NEW BULLETINS

(Continued from page 32)

lustrated catalog. Covers the complete line of guns for every soldering requirement and features new light-duty model with dual spotlights. Gives detailed descriptions and lists prices. Weller Electric Corp.

Splicing Sleeves (3H). Explicit 16-page instruction bulletin, fully illustrated with simple drawings and charts, covers such subjects as selection of Hysplices, tools and dies; preparation of conductors for splicing; proper indenting method; and installation of repair sleeves. Also included are practical suggestions for overcoming certain everyday problems observed in a survey. Burndy Engineering Co., Inc.

Cutting Wheels (3J). Moisture-proofed abrasive cutting wheels are described in 6-page folder. Illustrates advantages and convenient features, which assure maximum cutting efficiency. Chicago Wheel & Mfg. Co.

VALVES, PIPING AND FITTINGS

Steam Traps (3K). Here are some of the features of this patented thermostatic trap: single bellows for all sizes, no seats to change for different pressures, larger capacities, fast snap-action, rapid air venting. Other features along with cutaway views, charts and tables are shown in 4-page bulletin. Sarco Co., Inc.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Expansion Joints (3L). Without maintenance, annealing, or tightening, and with pipe thrust completely absorbed, MagniLastic expansion joints are giving trouble free service. "Expansion Joints at Work" tells a 4-page picture story of typical installations and applications. MagniLastic Div. of Cook Electric Co.

Flexible Metal Hose (3M). Catalog containing the latest data should prove a valuable working tool in design and maintenance departments. Compiled so that cross references and footnotes are completely eliminated. Includes sections on interlocking high pressure hose, air-jacketed hose for diesel exhausts, conveyer hose for ventilating and exhausting, and seamless high pressure hose. Couplings applicable to the various hose comprise the last section. Atlantic Metal Hose Co., Inc.

Drainage Pipe (3N). Overcome problems of structural failure and corrosion in drainage structures. Asbestos-Bonded pipe combines the strength and flexibility of corrugated metal pipe with positive protection against corrosion. Folder tells how these structures are

(Continued on page 138)

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All Aldrich Pumps Have **STAYING POWER**

. . . will not "dry out" under stress of heat or from non-use during shutdown periods. Special Palmetto compositions keep Kup resilient at all times . . . makes Kup the perfect answer for longer life, less downtime, of air cylinder operated equipment.

ANOTHER THING: Kup is stronger at the heel—because the synthetic compound, reinforced with fabric, is molded to shape under heat and pressure—not stretched to shape!

Palmetto Kup is available, with or without fabric, in various compositions and hardnesses to suit every hydraulic and pneumatic application.

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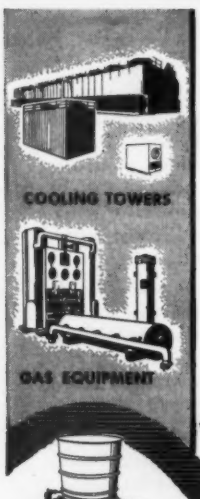

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(Continued from page 136)

made and summarizes corrosion tests that demonstrate the durability of the material. Armco Drainage & Metal Products, Inc.

Control Valves (3P). Why you get smooth, turbulent-free flow and other desirable characteristics when using diaphragm control valves is explained in 4-page bulletin. Lists inner valve types, sizes and dimensions. Kieley & Mueller, Inc.

HEATING, VENTILATING AND AIR-CONDITIONING

Pressure Blower (3Q). The manufacturer claims this direct drive, axial flow pressure blower sets higher standards of efficiency, economy and maintenance-free dependability in the most severe services. Capable of moving 100,000 cfm in a great variety of industrial ventilating applications involving duct systems. Engineering data, specifications and dimensions are included in this 18-page bulletin, plus photos, charts and drawings. The Moore Co.

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Dust & Fume Control (3R). Hot and corrosive gases may be efficiently and economically handled with cloth tube type collectors. New fabrics, including synthetics, make it possible to recover in excess of 99% by weight of fumes entering the collector. The collected material can be reprocessed without dewatering, filtering, or drying. Operation of these collectors is described in 8-page bulletin. American Wheelabrator & Equipment Corp.

MISCELLANEOUS

Corrosion-Resistant Coating (3S). Interested in an acidproof or acid-alkaliproof coating? Here are two that may solve your problem. The properties of Acidulum, which conforms to specifications for an inside or outside coating of sulfuric acid wet batteries, and Serin, which is inert to highly corrosive chemicals, are described in 4-page bulletin. Included is a description of two waterproofing compounds. Service Industries.

Adhesives, Coatings and Sealers (3T). Properties of over 100 industrial adhesives, coatings and sealers are tabulated in 32-page illustrated catalog. Also announces that more than 1000 formulas are available. and offers research help in selecting the right product for the job. Minnesota Mining & Mfg. Co.

Heavy-Duty Oils (3U). Of interest to production men in plants where contamination and rust are problems, and where bearings are operating under heavy loads is this 12-page illustrated booklet. Describes how these oils perform in circulating and hydraulic sys-

tems, compressors, and gear boxes. Sun Oil Co.

Corrosion-Proof Cements (3V). Bulletin describes complete line of resin, sulfur, silicate and asphaltic cements. Compiled in handy chart form that helps in the selection of the correct cement for a specific application. Information on Alkor 5E, the nearest thing to a universal corrosion-resistant cement is included. The Atlas Mineral Products Co.

Specialty Paints (3W). Maintenance problems of equipment and buildings are analyzed and recommendations made for economical upkeep in a Maintenance Portfolio. Describes specialized paint coatings for resisting moisture, fire, mildew and chemicals. The Wilbur & Williams Co.

Metallizing (3X). Process for making mechanical repairs and protecting surfaces against corrosion and contamination is presented in 4-page bulletin. Profusely illustrated with application and technique pictures. Metalweld, Inc.

Hydraulic Oils (3Y). Importance of using the correct hydraulic oil to obtain higher production speeds, precise control, and longer production runs is stressed in 8-page booklet. Directed primarily to executives and oil buyers without technical backgrounds. Chart showing the useful life characteristics of the oils, in relation to time and temperature, is included. Case histories are pointed out. Sun Oil Co.

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Exceptionally convenient where space is limited, this stock simplifies pipe threading close to walls, in corners and wherever operating room is restricted. With *adjustable* dies (cut exact, over or under size threads) it is an ideal tool where valves and fittings are being installed or maintained.

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NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

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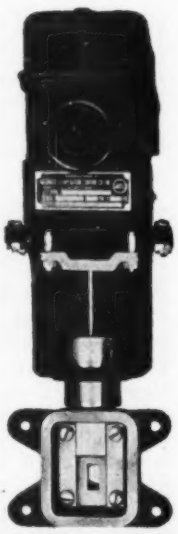
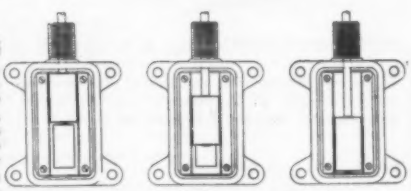


Applies Slide Valve Principle to Minimize Pressure Drop and Turbulence — Eliminates Clogging

AUTOMATIC CONTROL
This Rockwell Valve can be equipped with electric motor (left), air diaphragm operator (right), with valve positioner, if desired; hydraulic cylinder, solenoid or other controls; or it may be manually operated.

SIMPLE DESIGN
Removal of valve cover exposes stainless steel internal parts for easy maintenance. The slide or blade and body are lapped to provide smooth, tight closure. No wire drawing, wear on valve seats, mislocation of contacting parts. Sizes—¼" to 2"; pressures to 300 p.s.i.

FREE FLOW
As shown in sketches, vertical movement of blade over the rectangular opening determines open area. Flow is straight through, without seats or bends with their restriction to flow and consequent pressure drop. Flow is directly proportional to the degree of opening.



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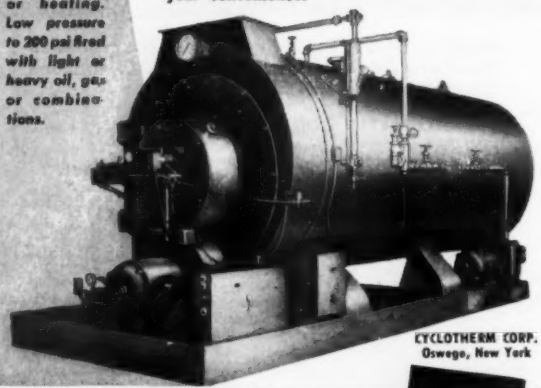

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(Continued from page 108)

to three units now operating; a 5,000-hp two-shaft compound cycle unit for power generation use; and a newly-designed 5,000-hp two-shaft mechanical drive turbine for gas-pipeline pumping and other applications.

Speed Final Consolidation Of Diesel Engine Factories

The first carload of Atlas Imperial Diesel engine patterns arrives at The National Supply Co.'s engine division at Springfield, Ohio. Atlas Imperial Diesel Engine Co. was

purchased by National Supply several weeks ago and the new owners are speeding consolidation of the two companies in the Springfield plant. Subsequent shipments from Oakland, Calif., Atlas Imperial's old home, will include finished parts, castings, tools, jigs, fixtures, and other material. Several patterns already have been put to work in furnishing three diesel engines for the Philippine Islands.

1950 Revision of Manual, "Finishes for Aluminum" Published

The 1950 edition of the process manual, "Finishes for Aluminum", has just been published by Reynolds Metals Co. These books are available without charge to engineers, chemists, production men and others when requested on company letterhead.

The new edition, a revision of the book first published in 1947, supplies basic information on the various processes for applying surface finishes to aluminum, and also details the characteristics of the finishes so produced.

It includes information on 10 cleaning treatments, 15 mechanical finishes, 16 chemically produced finishes, 11 electrolytic oxide finishes, organic finishes, and specialized finishes such as luminous paints and vitreous enamels. A section is also included on controls and tests.

The new edition also contains much data in tabular form including step-by-step schedules for applying various types of finishes, data on properties and characteristics of the aluminum alloys, action of some chemicals on aluminum alloys, their relative resistance to corrosion.

Included for the first time is a guide for approximating typical costs of applying 20 different treatments to aluminum. Another table gives typical finishing practices for a wide variety of aluminum products to serve as a suggestion when selecting a finish. The 124-page, 6 x 9-in. book contains 37 illustrations, 18 tables, a table of contents and an itemized cross index. It is wire bound to lie flat when opened.

AVAILABLE REPRINTS

Copies of the complete editorial section of the September, 1949 issue, describing the plant engineering activities of the General Motors Corporation are available in a separately bound brochure. Price including mailing is 25 cents.

We also have a few copies of the following article reprints that are available free of charge to interested parties:

"Air Conditioning Cab Of Shovel Handling Steel Mill Slag", December, 1949.
"Boiler Houses Are Necessary Evils", February, 1950.
"Caribou Diesel Plant Built in a Hurry", February, 1950.
"Chain Belt's Newest Boiler is First 'Step' in 3-Step Plan", W. J. Theuerman, October, 1949.
"Crankcase Explosions are Rare—But . . ." October, 1949.
"Diesels In A Hydroelectric System", June, 1950.
"Electro-Motive's Steam Plant is Tops in Modernity", V. L. Wesby, September, 1949.
"Engineers 'Raise the Roof' for Harnischfeger's New Boiler", Anthony Sinclair, December, 1949.
"Falls City Production Not Hampered During Recent DC to AC Changeover", July, 1950.
"Gage Glasses, Their Composition and Selection", July, 1950.
"GM 'Utilities' Receive Major Attention", H. R. Smith, September, 1949.
"Grievances Can Be Avoided", April, 1950.
"How To Select Correct Steam Trap", Thomas Trail, January, 1950.
"How To Select Corrugated Expansion Joints", June, 1950.
"Insulation on 2000 psi Boiler Proves Effective", R. H. Boothby, October, 1949.
"Keep It Clean, says Oldsmobile", R. H. Barlow and W. E. Rasmussen, May, 1949.
"A Lamson Installation", Calvin A. Burton, August, 1949.
"Low Cost Auxiliary Power From Turbine Drives", April, 1950.
"Modernization at Toledo Laundry Cut Steam Costs in Half", H. A. Quinn and S. T. French, October, 1949.
"Monsanto Builds Ideal Process Steam Plant at Everett, Mass.", June, 1950.
"Petoskey Diesel Plant Designed With An 'Eye-to-The-Future'", May, 1949.
"Progress Being Made In Shale-To-Oil Program", R. A. Cattell, November, 1949.
"Qualifications of an Effective Industrial Supervisor", A. A. Potter, June, 1949.
"Select Correct Batteries for Starting Diesels", K. A. Vaughn, November, 1949.
"Signode Plant 'Pressurized' to Eliminate Cold Drafts", November, 1949.
"Simplify Determinations of Pipeline Pressure Losses", J. O. Mullen and H. D. Fisher, November, 1949.
"Steam, Air, and Power for 3 New Ford Assembly Plants", R. M. Doering, May, 1949.
"The Story of Thermal Electric", A. G. Purdue, March, 1949.
"Supervisors Must Develop Favorable Group Attitudes", Edmund Mottershead. November, 1949.
"Supervisor's Personal Check-Up Chart", November, 1949.
"Water Treatment for Air Conditioning Systems", Wm. A. Tanzola, May, June and July, 1949.

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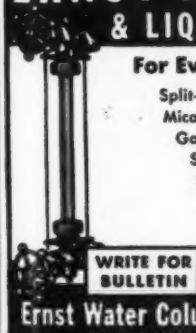
Try Cocks, Etc.



WRITE FOR BULLETIN

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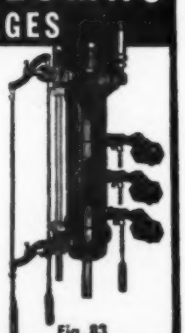
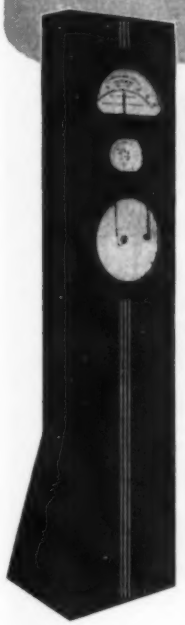
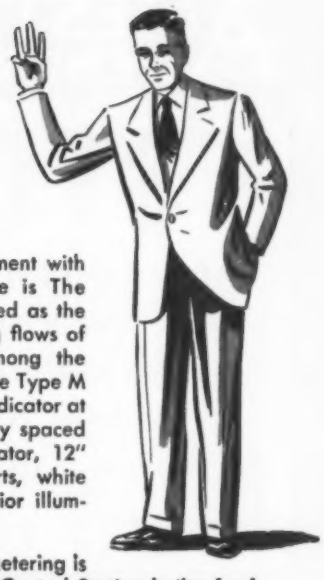


Fig. 83

You Can Trust The Venturi Meter for ALL the FACTS about Flow!



RATE OF FLOW
TOTAL FLOW
RECORD OF FLOW



Builders Type M Instrument with Builders Venturi Tube is The Venturi Meter recognized as the standard for measuring flows of boiler feed water. Among the important features of the Type M Instrument are its 10" indicator at eye level with uniformly spaced scale, improved integrator, 12" uniformly spaced charts, white pyralin dials and interior illumination.

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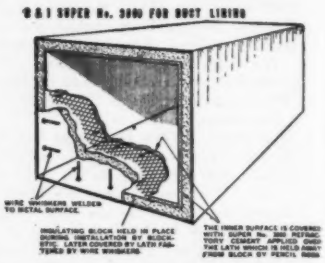

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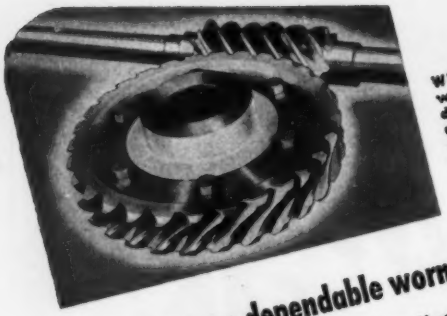

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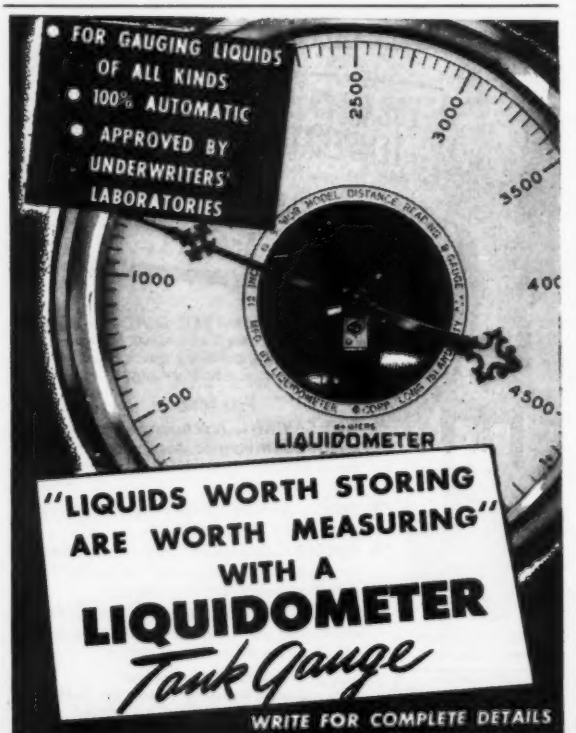

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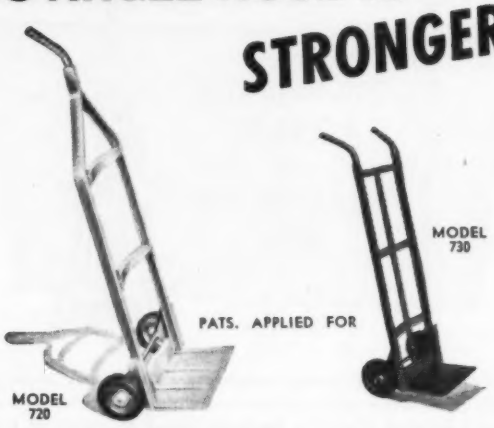

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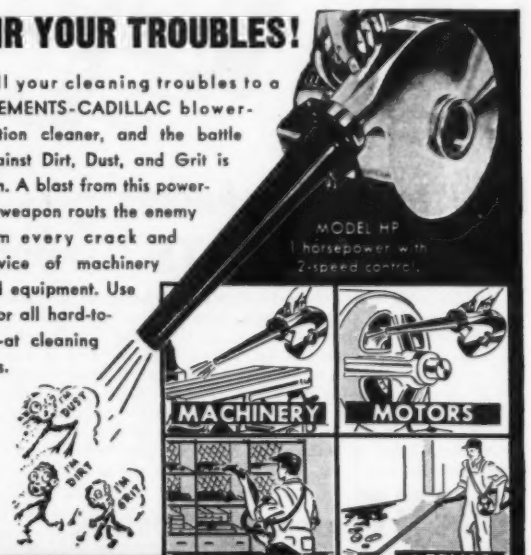

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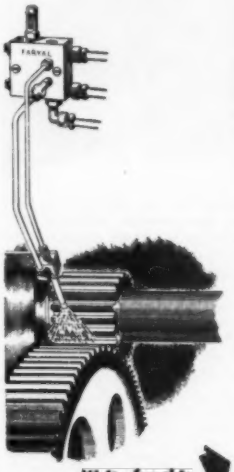

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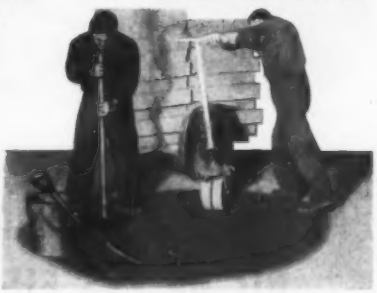

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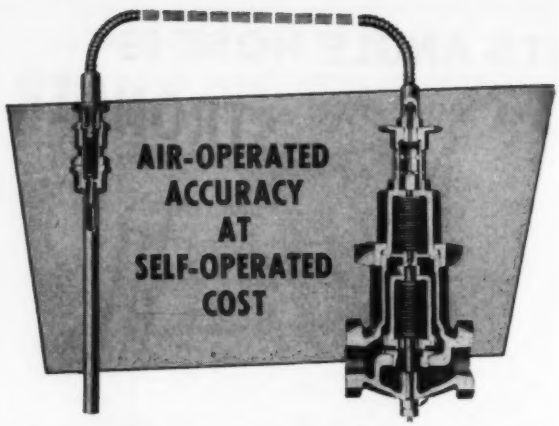

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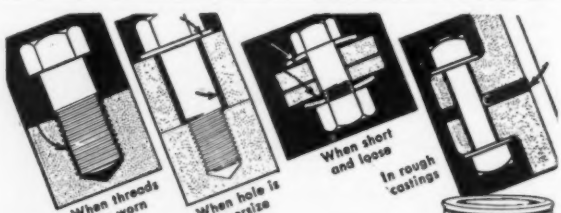

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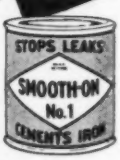

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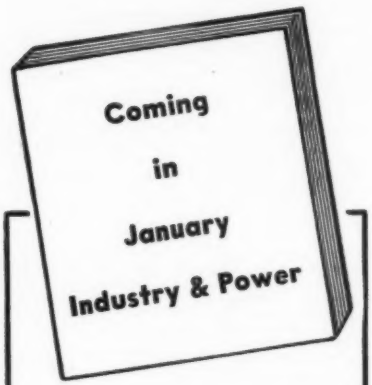

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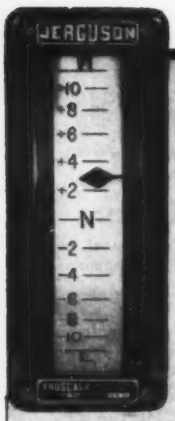

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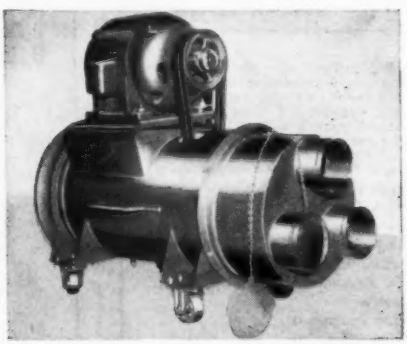

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